DOCUMENT RESUME

ED 250 059 PS 014 448

AUTHOR Jaworski, Anne Porter; Brummel, Brenda
TITLE Introducing Computer Education into an Early Elementary Curriculum.
PUB DATE Jan 84
NOTE 87p.
PUB TYPE Reports - Research/Technical (143)

EDRS PRICE MF01/PC04 Plus Postage.
DESCRIPTORS Computer Assisted Instruction; *Computer Literacy; Creativity; *Elementary School Students; Grade 1; *Group Activities; Learning Strategies; Literature Reviews; *Mathematics Skills; Primary Education; *Problem Solving; Student Attitudes
IDENTIFIERS *LOGO Programing Language; Piagetian Tasks; *Piagetian Theory

ABSTRACT

In addition to reviewing the literature on the pros and cons of computer use in the schools, this document reports the results of a research project in which 13 pairs of first graders learned to use the LOGO computer language over a 10-week period as part of their classroom activities. The first two chapters discuss the overall question of computer use in the school and review literature pertaining to the following areas: (1) reasons for using computers in the classroom; (2) arguments for using either computer assisted instruction or LOGO in the classroom; and (3) Piagetian theory that supports the use of LOGO in the classroom. Research methodology is described in the third chapter. The 11 research hypotheses concerned the ability of children to learn skills specific to controlling the computer as well as cooperative and individual problem-solving strategies, creative expression in a new medium, and abstract math and geometric principles. Data were subjective and included anecdotal records of each student, observations made by the classroom teacher, and information from each student's work file. The final chapter concludes that the research hypotheses were supported, that findings from other studies about the beneficial effects of working in small groups were confirmed, and that the computer instruction met the requirements of a Piagetian task. (Author/CB)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

U.S. DEPARTMENT OF EDUCATION
NATIONAL INSTITUTE OF EDUCATION
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

☐ This document has been reproduced as received from the person or organization originating it.

☒ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official NIE position or policy.

INTRODUCING COMPUTER EDUCATION INTO AN EARLY ELEMENTARY CURRICULUM

Anne Porter Jaworski, Ph.D.
Brenda Brummel, M.A.T.
Oakland University
Rochester, Michigan

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY
Anne Porter Jaworski
TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

January 1984

ED250059

PS 014448

TABLE OF CONTENTS

CHAPTER		Page
I	INTRODUCTION	1
	Significance and Justification	1
	Purpose	4
	Limitation	4
II	REVIEW OF THE LITERATURE	6
	Why Use The Computer in The Classroom	6
	How to Use a Computer in the Classroom: CAI or LOGO	14
	Educational Theory Supporting the Use of LOGO	25
III	PROJECT AND METHOD OF ANALYSIS	33
	Subjects and Setting	34
	Flow of Project	35
	Method of Analysis	39
IV	RESULTS	42
	Evaluating the Hypotheses and Dr. Britter's Curriculum Goals	42
	Analysis of Working in Pairs	55
	Can This Project be Labeled a Piagetian Activity	57
V	CONCLUSIONS AND RECOMMENDATIONS	60
	Overall Conclusions	60
	Suggestions for a First Grade Computer Curriculum.	61
	Suggestions for Future Research	62
BIBLIOGRAPHY		63
APPENDICES		72

CHAPTER I

INTRODUCTION

The intent of this chapter is to introduce the overall question of computer use in the school, to justify a study of computer use in the school, to list the hypotheses which the study, within its limitations, intends to investigate.

Significance and Justification

With the computer's introduction into the classroom to facilitiate learning, its use and need have been questioned. As the use of the computer spreads into all aspects of life, most educators agree about the inevitability of the computer being brought into the curriculum. In their adult lives, the students of today will have to interact with computers of one form or another. The interaction may take the form of merely responding to the computer in a feedback mode; or, being able to use the computer as a creative tool. In one situation, the person is limited and controlled by the computer, as opposed to the other situation in which the person is in control of the computer.

Educators do not agree on how the computer should be included in the curriculum or at what age level computer education should begin. To date, the computer has been implemented, primarily, at the secondary level and restricted to mathematics. Gradually, the

computer is being introduced into other subject areas and to some elementary students, usually as a drill and practice machine. As educators look to the future for the computer in learning, some advocate that it not be limited to one facet of the curriculum, but that the computer serve every student and every subject (Howarth, 1983). Further, computer educator John Martin (1982) sees the computer as possibly making major changes in the educational system. He states, "We should look to schools as socializing institution for humanization of the race. The computer may strip the school of its drudgery and inefficiency, elevating it to a beautiful sustaining function within our society." (p. 64)

Many areas of potential research have been proposed to answer the question of how and when computer education can best be facilitated. Arthur Luerhman (1980), established computer educator, has advocated research in the following areas:

1. Role of computers in cognitive development
2. Role of computer graphics
3. Age level at which computer usage can be introduced and taught most effectively.

This has further led him to the question - is it more important to learn to use a computer than to learn subjects that are now being taught? Also - can the computer be used to teach students of varying abilities and needs?

Another leading proponent of computer use and one of the developers of LOGO, Dan Watt (1982a), played the devil's advocate

by stating "there are questions about the effectiveness of LOGO in school settings. Claims made by Papert and other LOGO advocates have never been subject to independent evaluation." (p. 54) Karl Zinn (1981), a University of Michigan professor concerned with computer education has posed many questions for research into this field. Among these are:

> "Which programs encourage creativity and why?"
>
> "Which of your computer activities results in your students doing more on their own?"
>
> "How are students best scheduled to use a microcomputer?"
>
> (p. 17)

In a recent newspaper article, David Sanger (1982) cited computer education as being ineffective and inefficient; and, questioned the lack of teacher training and quality software as the cause for this problem.

These questions must be answered in order for administrators and teachers to accept computers as an integral part of the educational system. Uses of computers which do not support traditional curricula and methods will require a change in attitude, especially on the part of regular classroom teachers, for such uses of computers may alter their roles as well as how they address various subjects. Therefore, the teachers, the administrators, and the taxpayers (who will have to finance the acquisition of computers) need evidence that the computer can be an effective instrument in an elementary classroom.

Purpose

The purpose of this project was twofold: in chap 3

1. To examine the hypotheses listed below as they apply to a group of first graders of diverse ability.

2. To develop a piece of software that can be used by this age group that will include the following elements: Drill and practice routines for skills germain to this grade level (i.e. math, sounds, spelling, alphabet order), a deductive reasoning game, and a game to improve concentration skill. The documentation accompanying this software would allow its use even for the teacher unschooled in computer use; and further, permit the teacher to have some control over the content (i.e. spelling list) so that the software would conform to a class's or individual student's need.

Through this approach, the students could have exposure to two facets of computer literacy. Using the computer program, written by the researcher, the students' interaction with the computer will be limited by the computer and the computer program as to acceptable responses. However, for the majority of their experience with the computer the students will be creating computer programs; and, therefore, experience being in control of the computer.

Limitation

Due to the lack of computers and time, this project is limited to one first grade at a local elementary school district over a ten week period. The school district draws from a suburban, generally middle class, community.

The scope of this ten week project was limited to investigating what one teacher and one computer could accomplish with twenty-eight

first graders, representing many ability levels. The students worked in pairs with each group having between fifteen and thirty minutes of computer time each week for the duration of the project.

CHAPTER II

REVIEW OF THE LITERATURE

The review of the literature pertaining to computer use at the elementary school level included three areas: (1) Why use computers in the classroom; (2) Arguments for using CAI or LOGO in the classroom; (3) Educational theory supporting the use of LOGO in the classroom.

Why Use The Computer in The Classroom

In a recent article, noted futurist, Alvin Toffler (Wollman, 1982) stated, "There is a conflict that cuts like an electric line through the entire structure of society between those with vested interest in the past and those who recognize that is no longer going to work...people feel threatened, uncertain, future shocked by too much change too fast." (p. 102) A component of this "line"is the difference in attitudes between those favoring widespread use of computers in the classroom and those who are apprehensive about their use.

Seymour Papert (1981), a leading proponent of computer use, noted that his critics feel that computers will dehumanize the education process, will lead to massive surveillance and thought control, and that children will become robotical in their thinking. Others (Hager, 1981 and Nilson, 1981) have cited the educators'

reticence to using the computer being due to fear of their job being lost to a computer. Moreover, Papert (1980) and Moursund (Hager, 1981) regard the history of conservatism in the field of education as one reason for the hesitancy for schools to readily adopt the computer as a tool in the classroom. In addition, the cost of the use of the computer in a time of severe economic depression and educational cutbacks is another practical consideration of those opposed to widespread adoption of its use (i.e. to provide each child thirty minutes of computer time per week would cost the U.S. educational system over one billion dollars whereas in 1980, only $273 million were spent on all audiovisual and library supplies (Grady, 1982).

To refute these criticisms and skepticisms, much has been written. Some advocates of computer use approach this from the "age of information and technology" framework. Such a view is taken by Catherine Tobin (1983) as she stated, "We are at a turning point in history, we are becoming a society in which the collection, management, analysis and use of information will assume even greater importance, knowledge and experience with information technology will be an essential element of all education." (p. 23) To cope with this new age, the hope is expressed (Zonderman, 1982) that the students of today will be less fearful of the new technology and will be able to master it rather than have it master them. In order to do this, Kay Walla and Virginia Brubaker (1982) stated, "It is

pedagogically sound to make the computer part of the learner's environment so that it becomes a recognized and accepted part of the total environment and loses its image as a strange, unknown or perhaps bewildering machine." (p. 57)

Other proponents of computer use have looked at its effect on the teacher and the student. First, to see the change in the computer could foster in the teacher's role in the classroom: rather than replace the teacher, Nilson (1981) took quite the opposite viewpoint. Currently, he sees the teacher as being caught in the paradox of needing to individualize instruction, but in order to do that, needing more time to handle record keeping, therefore leaving less time to individualize teaching. Nilson feels the computer could take over the record keeping and some other basic jobs, thus letting the teacher truly individualize instruction. This attitude is echoed by Mima Spencer and Linda Baskin (1981) as they stated, "Computers can free teachers for the complex tasks of analyzing children's needs, choosing instructional sequence and arranging learning experiences for children that are suitable for their age level and development." (p. 15)

Moreover, as the teacher and students combine their efforts on the computer, they become co-workers or co-discoverers of the truth (Dwyer, 1980c). In this environment, Dwyer stated that the teacher served as a critic and encouraging audience, sometimes being surpassed by the student in ability to control certain aspects of computing. Therefore, computer education champion, David Moursund

(Hager, 1981) feels that the teacher role could be changed from an instructor to an overall facilitator and coordinator, actually allowing him/her to stress the human part of education. Furthermore, he believed that his work with teachers has reinforced his view that humans are the keys to educating other humans - aided not replaced by computers.

The effect of the computer on the student can be analyzed in three different contexts: academic, social, and affective.

Due to the recent advent of the computer in the classroom, few statistical studies have been done on how computers are effecting the academic achievement of students. For one thing, there is a lack of tests for some areas in which it seems the computer has been successful (i.e. lack of tests to show how sixth grade students are doing in problem solving or in geometry - Watt, 1982b). However, in one research project conducted by James Kulik (Bracey, 1982), the students who had been exposed to computers did score higher in math achievement tests, showed better retention, and took less time to learn material. The study, conducted over a four year period, further showed that those students who had twenty minutes a day on the computer made twice the gain as those who had ten minutes a day. In other research, Carl Berger, observed improved problem solving skills with computer use. Improved math test scores and improved strategy by a group of gifted students was also reported (Stein, Pitscha, Caputo, 1981).

Many areas of the academic environment are being effected where computers are being used. For example in computation, Jon Zonderman (1982) noted that the computer's aid has eliminated much tedious work and problem solving has become the focus of the classroom. This emphasis on the student being concerned with the process rather than the product is noted by others (Bork, 1980c; Rousseau and Smith, 1981). Moreover, the computer is able, according to Dwyer (1980), to melt away the constraints of the real world and demonstrate to the student concepts and ideas previously almost impossible to convey. This is true in the area of math, science, and in the use of simulations. In the latter, in the case of using such things as "Oregon Trail," the students are presented with an array of learning (The, 1981), such as geography, math and science, problem solving and decision making in a real and meaningful way. Moreover, he always has the option of starting all over again to see if he has really learned anything from his past mistakes.

Another academic area effected by the use of the computer is writing. In using the computer as a word processor, Seymour Papert (1981) felt that writing may become as important as speaking as the computer will require it. By using the computer, he continued, the child will be given a sense of power and become master of an adult activity as the product looks professional. In discussing the use of the computer as a word processor, noted author Issac Asimov pointed out that "Revisions are a snap...second revision is fun." (p. 25) Along this same line, Henry Old, Jr. (1981) stated that a

new measure of freedom with words is experienced by using the computer as the ability to modify and rearrange text is an easy task. In working with a six year old girl, Robert Lawler (1971) found success in teaching the child the basic form of a story. Moreover, in the Brookline Project (Watt, 1979), some of the students displayed marked improvement in creative writing with the use of the computer.

Contrary to those who feared that the computer would isolate students, the Kulik research showed evidence of more cooperation and collaboration. Moreover, Jon Zonderman (1982) reported that he observed students being less competitive as the computer fostered cooperative work among the students as the goal was not to complete but to problem solve. Such reaction was also noted at a New York school experiment with computers (Watt, 1982b). In other research noted by Mima Spencer and Linda Baskin (1981) it is perceived that those students who do collaborate in using the computer often teach each other and that such computer-oriented group work may actually provide a positive socializing experience. Therefore, not only does pairing on the computer have positive social ramification, but it is also advantageous for time efficiency and for peer assistance (Walla and Brubaker, 1982; Isenberg, 1981) and for seeing more possible solutions to a problem.

Going back to the Kulik research (1982), computer use was seen to have an effect on the student's affective domain also. Kulik reported more positive feelings about computers, a feeling of more control, and students sensing that they could learn at their own

pace. In two research studies examined by Daniel Watt (1982b) the affective change was noted. In a school in Edinburgh, Scotland, the researchers could not define much change in academic achievement, however there was noticeable improvement in the student's attitude toward math after using the computer. Moreover, in the "Computers in School" project in New York, the teachers discerned "some striking changes in the kids' relationships to schools and learning as kids who had not been successful in school got turned on." (p. 130) This finding was reiterated by Jon Zonderman (1982) as he observed that both students who were self guided and those who needed more outside direction were responding strongly to the computer. In a first grade experience with computers, Nellie Bandelier (1982) cited some parental reaction as to how their children were responding positively to the computer. She quoted one parent as saying "Any learning aid that teaches and is fun while it teaches is a student's dream." (p. 39) Perhaps, an additional question in the area of affective learning is the parent-child relationships that seem to be sharing a common goal in learning to use the "home computer." (Spencer and Baskin, 1981)

In summary of why to use a computer in the classroom - Alfred Bork (1980b) stated "By the year 2000 the major way of learning at all levels and in almost all subjects will be through the interactive use of computers." (p. 53) From a practical approach, Lee The (1981) commented that every occupation will require a working knowledge of the computer and lack of the knowledge will translate into lack of

earning power or promotions. Therefore, the opportunity to use the computer to design tools, solve problems, or do other tasks will be commonplace for the next generation. Henry Olds (1981) remarked that the education person will be comfortable with many strategies for structuring data, representing knowledge and creating unique tools for applying these strategies. Consequently, he surmised that the only way to attain this level of development is to give the students experience with the computer, so that just as we have acquired a literacy about automobiles, televisions, typewriters, and calculators, we may acquire a literacy about computers - not by reading about them but by using them. Thinking along these lines led several authors (Luehrman, 1980; Gambrell, 1979; Tobin, 1983) to the conclusion that the illiterates of the next generation may well be those who cannot program a computer or make use of its capabilities. Therefore, Seymour Papert (1977) envisioned the following situation, "We have to demonstrate to a generally skeptical world that our computer based learning environment can be operated in an ordinary school setting by teachers who are not computer scientists and that the students gain something valuable and unique from this experience." Papert believed that real value of this experience is in students learning to think systematically and in learning to identify different cognitive styles so that they might choose an appropriate approach to solving a problem. Cynthia Solomon (1982) expanded upon this idea as she observed that the computer accommodates different learning styles to reach the same goal. Moreover, the computer not

only allows for different styles, but facilitates a trial and error approach, so that it equips people to deal with partial failures and to seek alternative ways to solving a problem (1980c). All of these attributes led Thomas Dwyer (Taylor, 1980) to conclude, "Computing placed in the hands of well supported teachers and students, can be an agent for catalyzing educational accomplishments of a kind that is without precedents." (p. 113)

How to Use a Computer in the Classroom:
CAI or LOGO

Some children will be using the computer to program and some will become absorbed in preprogrammed activities (Nelson and Friedman, 1981). Arguments for both types of activities have been voiced, as well as those supporting a blend of the two.

First, to look at some of the reasons for choosing computer assisted material, commonly known as CAI. Jerry Johnson (1983) defined CAI as "the direct use of the computer to assist, replace, or enhance the instructional process. CAI can include software programs described as drill and practice, tutorial, problem solving, simulations, gaming and informational." (p. 46)

Jeff Nilson (1981) stated that the educational community will have to recognize that the computer can handle the teaching of some basic skills more efficiently than having a teacher manage the instruction. To do this, the computer can impart information on a one to one basis with a high success rate when well written programs are used (Herriott, 1982). Moreover, the CAI material can contain

either remedial help or enrichment material within the program. Therefore, the computer can select appropriate exercises based on the answers to previous questions. In doing this, the student is given instant feedback and help for an incorrect answer or positive reinforcement for correct answers (Heck, 1983). At the same time the computer can keep accurate track of how the student is progressing. This provides for individualization. As Tom Hager (1981) noted, the higher quality of individual feedback provided by the computer allows the student to be more in charge of their own learning as they can pace themselves in the learning experience (Luehrman, 1980). Some authors (Taylor, 1981 and Heck 1983) have mentioned that one of the strong arguments for using the computer for a teaching tool is its infinite patience. Moreover, it lacks any prejudice in dealing with the students (Bork, 1980b).

Looking at another aspect of CAI material, Bork (1980a) pointed out that the graphics in a computer program serve a twofold purpose: They can help to demonstrate a very difficult idea and they appear to motivate the student. Moreover, the graphics, especially for the very young, can help to make the feedback so obvious that the young child can understand whether he/she got the answer correct or why he/she failed to answer it correctly (Hungate, 1982).

Henry Olds (1981) summarized the need for quality educational software for CAI use as he discerned the need for quality standards in several areas: Content, so that the concept being taught will be given many forms of expression, allowing the student many

opportunities to experience the concept; cognitive development, so that learning will take place with the use of the program by responding appropriately to correct or incorrect answers; pedagogy - the quality of interaction between child and the learning environment, and, is "concerned with the nature of the interaction that takes place and seeks to create the conditions that enhance communication with the learner" 9p. 70); software design - to make clear the purpose and why the computer is the most appropriate for the task of teaching that material and to make use of all available modes of the computer to express the concept; and, whenever possible, allow the student to review his work and provide help for more understanding if that is needed.

The defense for CAI is that it has been proven successful (Bork, 1980); that it can be good as it can free the teacher for more important teaching tasks (Bork, 1980a) and that the students instead of the teacher can become responsible for himself, thus changing the center of education to the student (Hager, 1981).

On the other hand, opposition to using CAI material has also been voiced. One of the leading adversaries, Seymour Papert (1980) advocated allowing the children to use the microcomputer for programming, as he feels that the drill and practice programs are an example of the "Qwerty Theory," which can be defined as (Goldenberg, 1982) "Traditions that dig themselves in after their original purpose, presumably a good one, has become obsolete." (p. 226) Instead, Papert has been one of the originators of a computer

language called LOGO. Jerry Johnson (1983) defined LOGO as "A higher-level language which allows young children to easily interact and solve problems with a computer." (p. 48) As Richard Eyster stated, "The great hope is that LOGO is not simply another computer language but an environment in which children can begin to build not with their hands but with their heads: A collection of toys only thought can touch." (p. 70)

In talking about the world of LOGO and its turtle graphics (the turtle being represented on the computer monitor by a small triangle over which the user has complete control in changing its location and having it draw as the user wills), some (Martin, Bearden, Muller, 1982) commented that the children play a much more active role in the learning process and in doing this make more effective use of the computer as a learning tool. This they compare to drill and practice exercises which they see as using the computer as an audio-visual aid. Seymour Papert (1982) expanded upon this idea as he felt that children use LOGO to make the computer do what they want it to do instead of being merely respondents as they are in the case of CAI material. Therefore, they will feel that learning is not something done to people, but something they do for themselves. This feeling is reiterated by Jaina Housey (1981) as she, in speaking of her experience with LOGO at the Lamplighter School (one of the first schools to develop a LOGO curriculum) related that the child becomes the teacher of the computer rather than being taught by it and is thus given a sense of power and mastery.

In discussing LOGO, some of the developers of the language listed several of its characteristics.

1. Turtle LOGO Has Neither a Threshold Nor a Ceiling. In other words, it appeals to the novice programmer as well as to the master programmer. Harold Nelson (1981b) reported that five and six year olds "take to LOGO as a duck to water." (p. 15) They can easily create colorful, dynamic displays. This involves the use of words, number and headings. Part of the reason for the "no ceiling" attribute is that the language is extensible, meaning the user can create their own commands (Grammer, 1982). Therefore, because there is no way to exhaust LOGO's potential, it would appear there is no artifical limit on what the user can do with the language (Lola, 1981).

2. LOGO Creates a Mini World Where the Concept of Attention Span is Not Applicable. In short, the child enters a learning environment in which being in control seems to completely absorb their attention. In the world of LOGO these mini worlds are commonly referred to as "microworlds." Goldenberg (1982) defined these as "a well-defined but limited learning environment in which interesting things happen and in which there are important ideas to be learned." (p. 219) Robert Lawler (1982c) defined these microworlds as "task domains or problem spaces," (p. 140) where the focus is on neat phenomena that are inherently interesting to observe. The relationship of the student to these microworlds is one of interaction. Turtle graphics turns the microcomputer into a unique learning environment, in which the creativity of the user is challenged and

thus positive interaction is promoted (Martin, 1982). The idea of a miniworld is described by Robert Lawler (1982a) as he discussed one of his young student's involvement with LOGO. He spoke of her creating her own little world where she was free to explore and develop her own ideas.

3. LOGO May Provide an Avenue For Curing Mathophobia, which can be defined as a fear of hatred of mathematics; or, if introduced early enough, LOGO may avert this fear or hatred from ever developing. Seymour Papert envisioned that LOGO will give the child a domain called "mathland" in which LOGO is spoken. Therefore, they will learn to communicate with a computer as a natural process like learning French in France rather than an American classroom (Nelson, 1981a). Papert believes that the power and appeal of LOGO, therefore, are that it makes math so accessible - almost second nature as the student develops the use of the language (Eyster, 1981). He (1970) avered that being a mathematician means doing rather than knowing, so that LOGO will put children in the position to do math rather than just to learn about it. Further supporting this view, Kathleen Martin (1982) remarked "They learn to use mathematics for what it really is: A language for problem solving and the computer for what it can do best - compute." (p. 58)

4. With LOGO, Learning Line Intervals Can be Done Without Noticing It. Much of what is learned by LOGO is done without the student even being aware of what they are learning. Many advanced

and abstract ideas become fun, understandable and playful (Nelson, 1981b). Computer models seemed to be able to give concrete form to ideas or concepts that previously were intangible or abstract (Papert, 1981). As the student draws various geometric shapes, angles and spatial relations are inherently grasped by the student, as Papert (1980) stated, "almost inherently." (p. 68)

5. With LOGO, There is The Thrill of Making Complex, Hierarchial Constructions. By this the author referred to the act of taking a big problem and breaking it into smaller steps and putting them in order. LOGO is called a procedural language (Grammer, 1982), as a set of commands can be combined to form a procedure, which can be named, and used independently as a subroutine. For example, a house could be broken down into two procedures called "square" and "roof" or "triangle." In Mindstorms, Seymour Papert (1980) described this, "In the LOGO environment, a procedure becomes a thing that is named, manipulated, and recognized as the children come to acquire the idea of procedures. Since our society is relatively poor in models of systematic procedures, it is believed that programming in LOGO will offer the child a chance to think of problems with a systematic approach (Papert, 1981). In another article, Thomas Dwyer (1980a) stated, "The general nature of computing and the natural way in which it invites problem segmentation allows for success on many levels." (p. 92)

6. LOGO Makes Use of Computer Metaphor - which means the child can take words he normally uses and apply them to the computer; such as the child can walk around in a circle and translate body movement to computer language. This has led to turtle geometry sometimes being called geometry in action (Lawler, 1980). Lawler further believed that this aspect of LOGO may allow all students to adopt a method commonly used by "smart" people, as they know that putting themselves in the scene, helps them to understand the problem through their own actions. Another author, referred to this phenomena as making the idea come alive (Solomon, 1976). Several authors have stated the role that intuition plays in all of this. For example, Kathleen Martin and co-writers (1982) feel that when children take "turtle walks" they are making the transition between their own physical world and the cybernetic world of the turtle using their own intuitive sense of body geometry to understand what is happening. Sylvia Weir (1981) reiterated this belief as she felt that as you command the turtle to move around the screen your intuitive knowledge about how your body moves around in space is mobilized. Seymour Papert (1980) described this as "it draws on the child's well established knowledge of body geometry as a starting point for the development of bridges into formal geometry." (p. 58)

One of the paramount attributes of LOGO that is voiced by Seymour Papert is that it allows a child to begin learning about different learning styles. In the final Brookline Report (Papert, 1979), one of the observations made in this research project using

LOGO was that the computer seemed to help externalize learning styles or approaches so that they could be confronted and understood by the students and teachers. Two of the styles noted were the student who solved problems from the bottom up, called the bricolage style. This was compared to the learner who addressed a problem from the top down, or the planner. In an earlier publication, Papert (1979) had stated his belief that a child's cognitive development benefitted from the child understanding the various learning approaches, such as rote memorization or problem solving. Then, they can tell when a certain approach is appropriate and develop their own strategies (1980). To explain this, he stated, "By learning to imitate mechanical thinking, the learner becomes able to articulate what mechanical thinking is and what it is not." (p. 27) Therefore, teachers may consider themselves not as the source of answers but as the facilitator of students discovering answers by theorizing about the problems (Riordon, 1982). This type of thinking leads one to conceptualize mistakes not as failures, but as bugs to be debugged (Papert, 1970). Thus, these bugs foster a trial and error type of problem solving with the bugs providing us clues to solving the problem. Sometimes the bugs actually lead to new insights into unexpected ways of achieving results (Solomon, 1976). Henry Olds (1981) in describing his experience with LOGO summarized this idea, as follows: He felt he had more complete understanding of concepts he thought he had already understood, as the bugs forced him to learn more about a topic. Each bug reflected with detailed accuracy the working of his own mind

and each lapse in his thinking. Therefore, these bugs are seen as building blocks, letting a student learn from errors rather than be intimidated by the threat of failure.

One other positive result that has been seen by those observing LOGO is the sharing that goes on between students. Harold Abelson (1981) reported that his students would share their experiences, explain exactly what they were doing and what they would do next. Moreover, Howard Austin (1976) in relating his experience of teaching teachers about LOGO commented "One of the best things about learning something new is the fact you can teach someone else what you have just learned. This feature of learning is particularly prominent in the LOGO environment." (p. 23) Seymour Papert related the following classroom scene, "Part of the fun is sharing, posting graphics on the walls, modifying and experimenting with each other's work, and bringing the new products back to the inventors." (p. 180) This same type of interaction is reported by Tim Riordon (1982) as he claimed that the sharing of ideas is a fundamental part of the LOGO environment. At the Bank Street College Computer Project, a teacher indicated not only does the sharing take place between students, but also between student and teacher (Jewson, 1982).

The use of LOGO and turtle graphics is seen as helping the student in many areas. For example, in teaching the computer to draw a picture, the student gains the knowledge about programming, geometric knowledge, arithmetic knowledge, general problem solving and learning to foster the use of one's own intuition (AI memo 48).

Its success in being used have been demonstrated and reported by the Lamplighter Project in Texas, the Brookline Project in Massachusetts, the Computer in Schools Project in New York, the Edinburgh Project (Watt, 1982) and the Punahou School in Hawaii (Lough, 1983). One aspect of this research has shown that the skill level of the student seemed to lack significance with LOGO. This has afforded students who previously have had limited or no success to experience success (Leventhal, 1981). In the Brookline Project (Watt, 1979), students of low academic standing demonstrated pride of accomplishment; and, in some cases, the new found confidence carried over to regular classwork. Furthermore, Slvia Weir and Daniel Watt (1980) reported that with disabled students, they were able to cultivate certain skills: Learn an approach to thinking that will eventually allow them to program other computers, develop logical thinking, learn to develop and test their own abilities, develop the ability to take independent action and sustain interest, increase self-esteem, make mistakes without fear of punishment, and gain information about geometric principles. To summarize the success she had with LOGO, Sheila Leventhal (1981) stated "We've seen phenomenal computer success in children who are artistically inclined, with children who particularly enjoy problem solving, with children who are somewhat intimidated with pencil and paper tasks, with children who may be having some difficulty with reading skills, with children whose reading skills are quite advanced, and even with children who are not yet reading." (p. 47)

Educational Theory Supporting the Use of LOGO

Seymour Papert, one of the principal developers of LOGO was a colleague and collaborator with Jean Piaget and seems to have brought his theory into the technological age (Eyster, 1981). Consequently, the ties between LOGO and Piagetian learning are very noticeable. The main thrust of Piaget's theory is that a child learns through experience and develops a framework for dealing with his environment in relatively predictable stages (Rousseau and Smith, 1981). Therefore, Piaget said that development is not solely a matter of biological maturation, but is a joint product of that maturation continuously interacting with circumstances (Hunt, 1981). Another theorist also saw this, as John Dewey stated that intellectual growth must be rooted in the child's experience (Papert, 1972)

Thomas Dwyer (1980) explained Piaget's theory of cognitive development, as follows: "A reorganization of mental structures which occurs when a person spontaneously acts on the environment, experiences disequilibrium, and assimilates and accommodates events." (p. 29)

Ellis Evans (1971) gave an example to explain this phenomena: A child sees a bat and assimilates that the bat is a bird as his comprehension or existing knowledge says, it flies - it must be a bird. However, he finds out that it is not a bird, so disequilibrium exists as this object (the bat) does not fit into his scheme of thinking. He then accommodates or rearranges his cognitive structure to this new reality that not all flying objects are birds, but, in fact, may be a mammal. Once this accommodation occurs, he is once

again in a state of equilibrium.

The first step in learning, therefore is assimilation, and LOGO is a language in which concepts can be introduced, understood and used from the basic of the child's previous understanding (Housey, 1981). In discussing turtle geometry, Seymour Papert mentioned using the old schemata or the child's body knowledge as an assimilative factor for building a new structure in the child's mind (1980). Piaget referred to this as "body transfer." (Pulaski, 1971) In applying this to LOGO, the child transfers his already acquired knowledge as to how his body moves (i.e. forward, backwards, left, and right) and uses these terms in guiding the turtle with the computer. In doing this the developers of LOGO were trying to shape the computer to be a part of a natural learning situation where the material to be learned would relate to the learner's past personal experience (Lawler, 1980a), or as he stated in another article (1980b), "Expand the application of existing knowledge to new experiences." (p. 45)

Moreover, Piaget (Ripple and Rockcastle, 1964) described the goal of education as the development of "men who are creators, inventors, and discoverers." (p. 5) This according to Evans (1971) meant that the objectives was not to increase knowledge, but to create possibilities for a child to invent and discover. To do this Piaget discerned three types of knowledge:

1. Physical Knowledge

   Discovery of what is in the real world (Kamii and Devries, 1978) which is derived from the object itself (i.e. feeling a rock and gaining the knowledge that rocks are hard).

2. Logical-Mathematical Knowledge

   The creation or invention of relationships (Kamii and Devries, 1978) caused by the child's action on the object such as a child inventing a paper airplane by acting upon the piece of paper.

3. Social-Arbitrary Knowledge

   Gained by interaction with other people, such as the rules and language by which a society exists (Wadsworth, 1978).

In all of these, it is the child who is at the core of learning and it is his actions that cause the learning to take place, as Piaget (Pulaski, 1971) has pointed out, "Knowing is action on objects." (p. 125)

The educational philosophy of LOGO is to place the learner in charge of the learning. The traditional method of teaching is to impose the formal structure on the children rather than letting them build up an understanding out of their activities. In this traditional mode, there is the danger that if answers are always provided, the child begins to disregard his own disequilibrium and fail to really accommodate the new information (Wadsworth, 1978). Piaget, in fact, argues for an increase in children's selection of activities, as he stated that children do not need to be motivated to learn, rather it is a natural activity of a healthy mind (Papert, 1981). Therefore, the teacher becomes a facilitator of learning, rather than a source for knowledge. Their job thus becomes to create an environment and atmosphere in which the child can be active and initiate and complete their own activities (Wadsworth, 1978 and Kamii and Devries, 1978).

In seeing how this interaction is accomplished in LOGO, Dan Watt (1982b) described one of the characteristics of a LOGO environment as one in which activities are carried out by the child controlling the computer; these are exercises meaningful to the children. In the Texas Instrument Curriculum Guide for LOGO, the environment was described as a simulation of the real world environment in which the child can explore safely as he or she progresses through the developmental stages; and environment that encourages learning by discovery. Moreover, the learning was assessed as being more successful as it served a personal need (i.e. spelling commands correctly, using correct numbers, using correct directional headings were all needed in order to reach the child-selected goal).

Overall then, Piaget and LOGO stress that individual action upon the environment is necessary for learning and development (Wadsworth, 1978). Seymour Papert (1973) drew the analogy of children needing to learn by doing as he noted that in the past the young were taken out and taught to hunt - not by reading about it, but by doing it. Now, with the computer, math applications can be similarly embedded into the learner's cognitive structure. In a sense, the learner can experience both the physical knowledge and the mathematical-logical knowledge, as he discovers, for example, the properties of numbers and sees the relationship between these numbers and other objects.

In doing this, the child is often in a playful frame of mind. As Alfred Bork (1980b) stated, "Play is a way of gathering under

highly motivated circumstances a variety of experiences," (p. 54) Therefore, the messing around a child often does at a computer may give him some real opportunities to assimilate and accommodate. Also, it may provide the child with an opportunity to be creative, as the child may be able to put together things that normally are dis-associated and come up with something new (Stuller, 1978). The same idea is carried forth as the child is allowed to make mistakes when acting on his instincts but corrects himself, therefore learning something (Wadsworth, 1978). In LOGO, this is seen as debugging or correcting a program (Watt, 1982a). However, being done in a healthy environment, the learning was seen by Piaget to be a pleasant experience (Reeves, 1965).

Finally, in LOGO, the social elements of Piaget's theory are not only used to teach the student about working with another human being, but also to enhance the achievement and creativity. Often, LOGO teachers will put two children at a computer at a time (Bandelier, 1982). The results have been beneficial as the two children seem to create networks whereby they exchange ideas and questions with one another and feed on one another's creativity (Stuller, 1982). This type of interaction and its benefits have been substantiated by research into the field of small group learning.

David Johnson (1981), who has done research in student-student interaction, observed, "Constructive student-student relationships are probably an absolute necessity for maximal achievement, socialization and healthy development," (p. 5) One positive attribute that

he noted is that peer relationships often contribute to students realizing there are many ways to perceive the same problems. In research that he conducted with two classes of first graders on drill review, conceptual learning and problem solving tasks, "cooperative groups" consistently scored higher (1980). In the testing, students were in groups of three - one low ability, one medium ability, and one high ability student. Whereas, some thought it was a case of the high ability student giving the answers, it was determined that:

1. High ability students performed better in a cooperative group than when they were put in an individual situation.

2. With the three students working together, their discussions led to developing more effective strategies to use.

Moreover, Johnson remarked, "These results are all the more intriguing, as they are with first grade students who are far more diverse in intellectual ability" than previously studied college students. (p. 91)

In other research, Johnson and his associates analyzed many of the previous research projects done on cooperative groups and concluded that cooperation is superior to competition in promoting achievement and productivity (1981).

Another researcher, Robert Slavin, corroborated these findings (1980). In several of his own research endeavors and a review of other research, he determined that the cooperative learning techniques are significantly better at producing higher academic achievement. Also, he found that such techniques have an affective

result: "Students in classes using cooperative learning generally report greater liking of school than do traditionally taught students." (p. 338)

Therefore, others have decided, as did Piaget and some of the LOGO proponents that interaction between children does enhance their education.

In conclusion, after several years of study with Jean Piaget, Seymour Papert was reportedly impressed by Piaget's way of looking at children as the active builders of their own intellectual structure (1981). However, Papert gave more weight to the influence that material could have on development than did Piaget. As a result, Papert believed that the computer would allow some thought processes to be undertaken by a child at an earlier stage. Thus Piaget's stages of development could be accelerated or, perhaps, changed (1980).

However, Papert and his colleagues do adhere to the Piagetian philosophy as Piaget has stated (Lawler, 1982), "If we desire to form individuals capable of inventive thought and of helping the society of tomorrow, then it is clear that an education which is an active discovery of reality is superior to one that consists merely in providing the young with ready made wills to will with and ready made truths to know with." (p. 138)

Or his more practical statement (Pulaski, 1971), "Much of what we teach children today will be outmoded by the time they graduate,

but critical insight and creative ideas will always be needed." (p. 200)

Moreover, it is the hope of those dedicated to computer education that the computer may finally provide a solution to the dilemma as seen by Santayana (The, 1981), "The great difficulty in education is to get experience out of ideas." (p. 55)

CHAPTER III

PROJECT AND METHOD OF ANALYSIS

This project was developed to investigate the following hypotheses:

1. Children can feel comfortable in a computer environment.
2. Children can begin to learn to think in terms of hierarchial problem solving (i.e. a computer requires logical steps in order to function).
3. Children can understand in concrete terms some abstract math and geometric principles.
4. Children can learn in an environment where trial and error is a natural way to address a problem.
5. Children can be active participants in the learning process.
6. Children can express themselves in a creative way both graphically and by the written word.
7. Children can learn to respond to their intuitive ideas and develop their uses.
8. Children can learn to express themselves in a computer language (use of LOGO commands).
9. Children can recognize components of a computer system and begin to learn the use of a computer keyboard.
10. Children can gain a sense of control over the computer as they realize they can determine what the computer does or does not do.
11. The computer can be used in such a way as to fit the criteria of a Piagetian activity.

Subjects and Setting

This project was conducted with a first grade class consisting of twenty-eight students. The school district was a suburban school district, which is predominately middle class. The class was taught in the traditional mode, with most of the time being spent on the basics of reading and mathematics. The students were ranked according to their reading ability within the Holt Basic Reading Series. The class range in the reading series was from level three, considered kindergarten or early first grade, to level eight, considered second grade level. Most of the students were reading at level six, which is at the expected level for this grade.

The project was designed so that the class met as a large group once a week and had demonstrated for them the material to be used on the computer for that week. Then, for the next two or three days, the students came to the computer, usually, in pairs. These pairs were selected by the regular classroom teacher. Her basis for selection was not a deliberate attempt to pair academic equals or varied ability levels, but rather based on students whom she thought would work well together.

The students had, for the most part, had no previous experience using a computer. Within the school itself, there were two computers; however, the one was used exclusively for a few office applications, and the second one was in disrepair for most of the time that this project was being carried out. The staff of the school lacked anyone trained in using the computer within their

classrooms. For this project, an Apple II plus computer with disk drive and color monitor was brought to the class by the researcher.

Flow of Project

After a discussion of computer uses that they observed in their everyday life, the students were introduced to the microcomputer. The students were given the names of the various components of a microcomputer system and a demonstration of some of its capabilities. To re-enforce their adding such words as "monitor," "disk drive," and "computer" to their vocabulary, the students were given a picture (see Appendix A-1) to color that displayed these words. Also, they received a diagram of the keyboard so they could begin to familiarize themselves with the location of keys (see Appendix A-2). These handouts were distributed for the first few weeks, with the students being instructed to color in the "keys of the week" (i.e. their name, or the letters of the commands they would be using that week).

Initially, the students' time with the computer was for the purpose of teaching them to properly load a disk, turn on the computer and the monitor, locate some of the most commonly used keys (such as the "return key," the space bar, and some of the letter and number keys), and to turn the system off, remove and store the disk. To accomplish this, the students worked with a preprogrammed disk to which they were asked to respond with such things as answers to math problems or solving an elementary logic problem.

Once the students felt comfortable with the mechanics of the computer, they were introduced to the LOGO language and its turtle. The language allowed the students to use a few commands to draw lines with the turtle, represented by a small triangle on the monitor. To do this, the child would give a directional or heading command followed by a numerical value. This would make the turtle draw a line forward or backward the desired number of "turtle steps" or change its heading the desired number of degrees. For two weeks, the students were allowed to create designs on the monitor by "fooling around" with the following commands:

FD = Forward

RT = Right

PC = Pen color (they could choose one of six colors) (see Appendix A-3)

BK = Back

LT = Left

To start to give them the idea of a program, the students were also "playing" with a programmable battery operated car, which they could program to go forward, backward, turn right or left, turn on lights or honk the horn. For each of these functions, they could select a time parameter, such as go forward for four seconds. The students also tried to follow the directions for programs that had the car go in a circle or in a figure eight, as well as do some courses of their own. In addition, the students used a measuring tape to see how far the car would go given various time and

forward commands.

Next, the students, working in pairs, wrote a program for the computer that would draw a square and then expanded the square into a house (see Drawing 3.1). In order to do this, the students played "turtle talk" in which one student would walk through the program. In other words, for the square, the shape was "drawn" on the floor with masking tape, and the student would walk around it, relating to the other child which direction he/she was going and whether he/she was going forward or backward. With the aid of a small plastic turtle, this procedure was re-enacted on paper with the commands being first written on paper then transferred to the computer. They were shown how to "save" their programs onto the disk and then how to "read" them from the disk. By adding the following commands, they further embellished their house pictures:

PU = pen up (turtle does not draw)

PD = pen down (turtle will draw)

BG = background color (6 colors)

HT = hide turtle (turtle still drew, but couldn't be seen and it drew faster)

The class was then given the option of using several pre-programmed shapes (square, triangle, circle, and rectangle) to be used by them in creating a design or picture. They could determine the size of the shape. For example, they could enter "triangle 100" and turtle would respond by drawing a triangle with sides of 100 "turtle steps." This activity was then extended. The children

NAME: _____

TO^ _____

RT^ 18 ∅

BC^ /

PC^ _____

FD^ _____

_____^_____

_____^_____

_____^_____

_____^_____

_____^_____

_____^_____

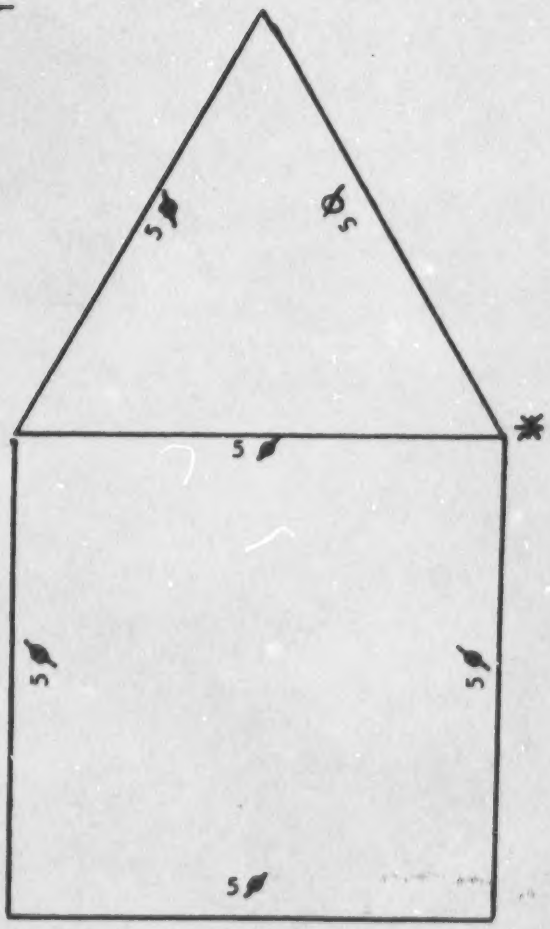
PC^ _____

LT^ 12 Q

_____^_____

_____^_____

_____^_____



^ = space bar

* = start here

3.1

were given construction paper cut outs of various sized circles, squares, rectangles and triangles. In addition, they were given a piece of paper the size of the monitor screen. By pasting the shapes and drawing lines on the paper, the students constructed pictures or designs of their own choice. Then, they wrote programs to draw these pictures on the computer. This they did with the aid of a protractor and a "turtle ruler" -- a strip of paper calibrated to the computer's "turtle steps." (See Appendix A-4) Each child then saved his/her program and had the program and the picture printed.

The class also did some word processing. As a part of their regular class, they frequently do a journal entry. One week, they did this on the computer, by entering their sentences and them having them printed. (See Appendix A-5)

Throughout these activities, the estimated average time that each pair spent on the computer was twenty minutes per week. There were three weeks during the project that the students worked individually. One of those weeks, the students were joined by several sixth grade students, who were involved in a separate computer project.

Method of Analysis

To analyze this project, the data collected included: The researcher's anecdotal records of each of the students, observation made by the classroom teacher, a file of all work done by each student, a test given to the first grade students by the sixth grade

students on the mechanics of using the computer, student comments and parental comments.

With the exception of the students being checked for being competent to operate the computer, the other observations are subjective. The lack of numerical statistics resulted from the novelty of this approach and the lack of time and a second control group. The justification for such subjectivity has been observed by others. Thomas Dwyer (1980) spoke of the difficulty of evaluating students, as he stated that some evaluation "cannot be translated into words or numbers anymore than can the emotional impact of a bach cantata." (p. 116)

John Herriott (1982) addressed this problem when he spoke of one of the most valuable assets of a teacher being her/his ability to make value judgments due to his/her experience. Consequently, he discounted those who demanded measurable evidence as he claimed a teacher could detect the enthusiasm in a child's eye and discern if a student had a flair for something. Moreover, those responsible for evaluating the Brookline Project (Papert, Watt, Dissessa, Weir, 1979) remarked about their reporting results by commenting, "It involves making interpretations of observed behaviors and conjectures about the nature of the obstacles the student had to overcome." (p. 113)

To analyze the study, there were four separate evaluations used:

1. Evaluate how well the students did in achieving the various aspects of the hypotheses (see Chapter 1).

2. Evaluate how the students did in achieving the objectives of a computer curriculum for first graders as proposed by Dr. Gray Bitter (1982). His goals for a first grade computer education were:

   a. Know what a computer can do.

   b. Learn to use a computer (i.e. load and run a program).

   c. Use the keyboard (i.e. write sentences).

   d. Continue use of LOGO graphics - by adding pen up and pen down to commands, the child should be able to draw faces, houses, automobiles.

3. Analysis of the students working in pairs.

4. Using a checklist (Evans, 1971), to see if the activity was a valid Piagetian activity. An activity is considered a valid Piagetian activity if:

   a. Teacher and children desire to continue.

   b. Sense of fun is engendered.

   c. Children are actively involved and persistent.

   d. New experience helps teacher become more responsive.

CHAPTER IV

RESULTS

The intent of this chapter is to examine the data gathered during the project and ascertain if it supports the hypotheses of the project and confirms the literature that was reviewed concerning working in small groups and Piagetian activity as it relates to learning with a computer.

Evaluating the Hypotheses and Dr. Britter's Curriculum Goals

One of the basic assumptions of this study and Dr. Bitter's curriculum (1983) was that first grade level students could be comfortable in a computer environment as they began to interact with the computer. During the project, the students' eagerness to attempt each activity and their frequent requests to have additional time on the computer indicated they did not suffer from computerphobia, but instead felt at home with the computer. Many were previously familiar with various video games, and this may have contributed to this relaxed approach. Moreover, they were careful in handling the disks and appeared to respect the machinery. Toward the end of the project, several sixth graders came in and "tested" the first graders on proper use of the computer, particularly taking care of the disk. All of the first graders were asked to demonstrate a certain group of tasks, and they all accomplished these with no

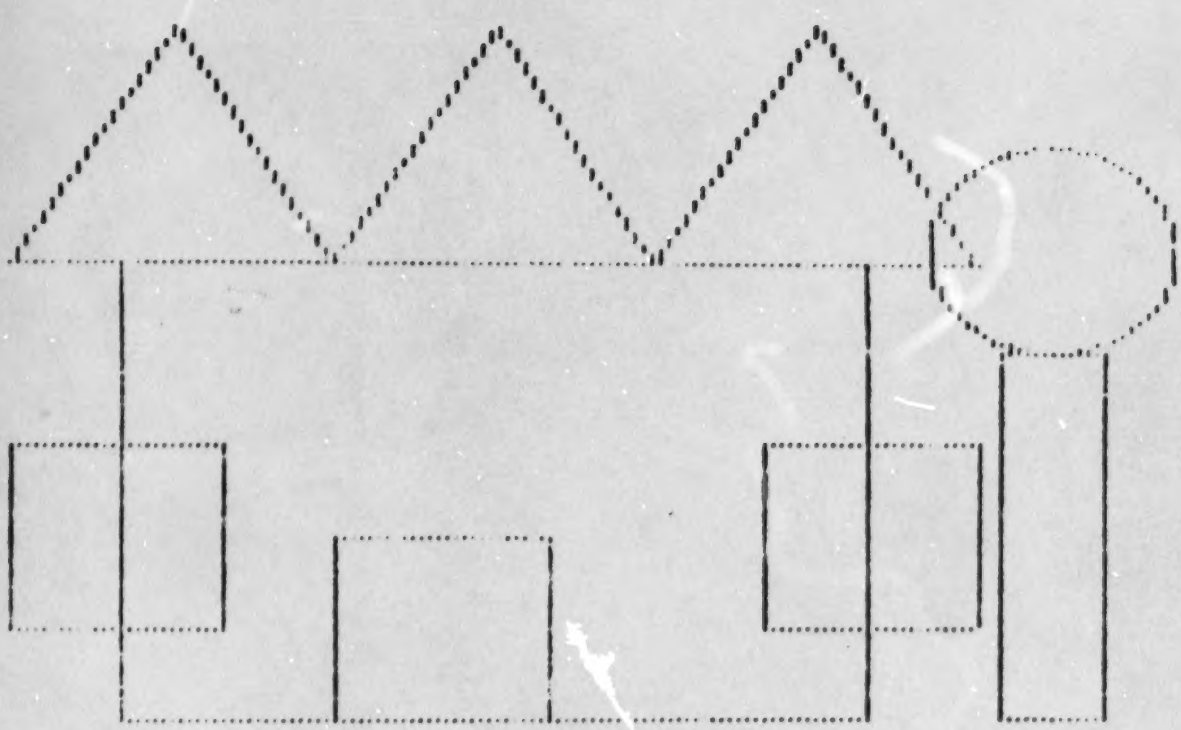
difficulty (see Appendix B-1-3).

The first graders used the "hunt and peck" method of typing on the computer keyboard. Although this method was at times laborious, with the exception of one or two students, the children became very adept at finding "familiar" keys, such as the return key, escape key (used for erasing characters), the space bar, the letters of their name, and the letters of the LOGO commands that they used the most. The students, in most cases, rejected any offer of help for finding the keys. There did not seem to be any correlation between a student's reading ability and his speed at finding and remembering keys. In fact, one of the girls in the lowest reading group was one of the best typists.

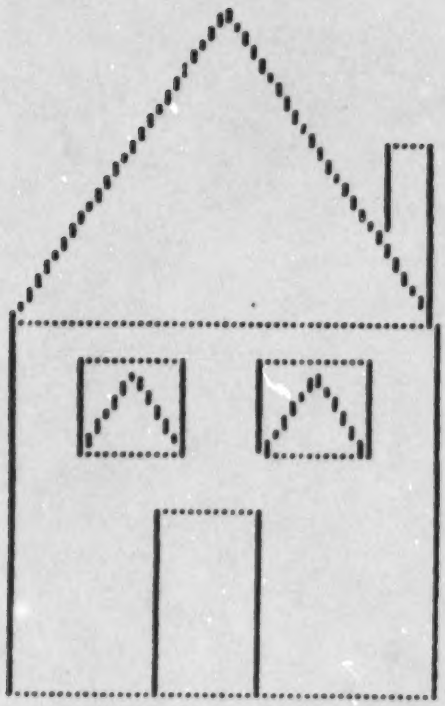
The next assumption was that the students were capable of demonstrating logical thinking. On their final project, all of the students exhibited some degree of logical thinking through developing their final graphic display. For this "project," each child created a design or picture by assembling various paper shapes (i.e. circles, triangles, etc.) on a piece of paper the size of the monitor screen. To transfer this picture to the computer, the child had to instruct the turtle to draw each shape or part, then move, draw another shape, and continue this process until the desired picture had been drawn. The difference in student ability could be noted in their using the shapes or making the correct turtle move by themselves or having it done by the researcher. Whereas one student (see Figure 4.1) wrote the word "kwindow" and the researcher

wrote the specific commands to draw the window. Another student (see Figure 4.2) wrote the individual commands to form the window - and put curtains in the windows. Another example would be one student (see Figure 4.3) who wanted to draw a girl and attached the problem by first drawing a triangle; but, instead of drawing the appendages herself, the child used the words "legs," "arms," "head," and "smile" thus leaving the researcher to write the routines for these. This could be contrasted with the procedures developed by the girl (see Figure 4.4) who drew a cat, by drawing circles (line A), instructing the turtle not to draw, moving the turtle to the top of the top circle (line B), instructing the turtle to draw, carefully measuring the ears, and drawing them (line C).

Another assumption was that children might begin to understand in concrete terms some abstract math and geometric principles. This is one area in which an accurate observation of any accomplishment was difficult to judge. Converting body geometry to the computer became second nature as far as directionality (right or left) was concerned. But the amount of that turn was difficult to convey. However, one parental comment was encouraging. One mother, who was a volunteer in the class, stood and watched a student (see Figure 4.5) "drawing" his boat on the computer. After the student left, she related that she had been trying to help him with some very elementary math problems and he had not seemed to understand it at all; yet, she had just observed him using a "turtle ruler"

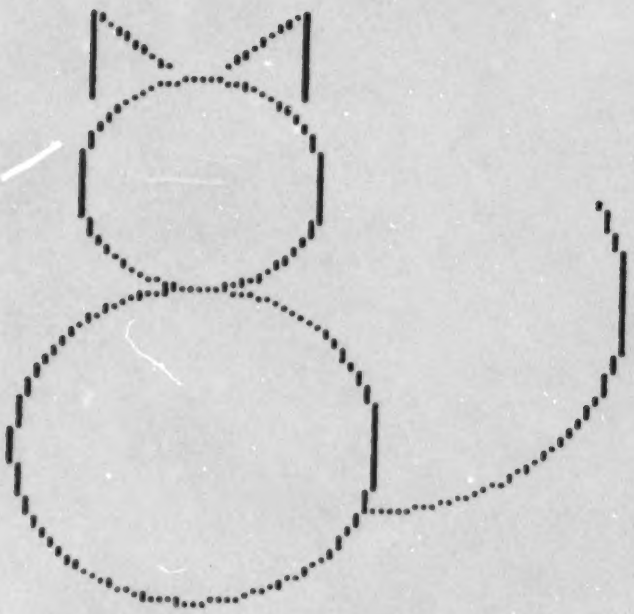


```
TO KENNY
PU BK 70 LT 90 BK 65 PD PC 5 FD 75
BOX 50 FD 100 RT 90
FD 25 KWINDOW FD 100
RT 90 BK 25 ROOF ROOF ROOF
BK 25 RT 90 FD 50 KWINDOW
FD 75 LT 90 PU
FD 30 LT 90 PD TALLTREE
END

ROOF
TRI 75 fd 75
END
```

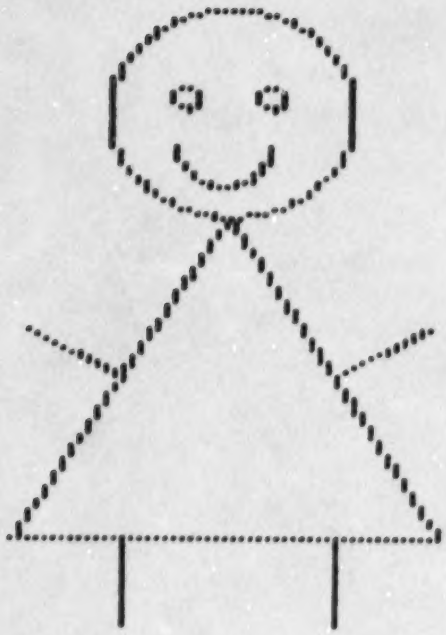


```
TO JAMIE
PU FD 25 RT 90 BK 50 PD
PC 5
BOX 100
PC 3 TRI 100 RT 90 PU
FD 35 LT 90 FD 16 PD LT 90
WINDOW RT 60 PU FD 43 LT 90 PD
WINDOW RT 150 PU FD 15 PD REC 50
PU RT 180 FD 50 RT 90 FD 40 LT 90
PD FD 50 LT 90 FD 10 LT 90 FD 25
END

TO WINDOW
BOX 25 RT 30 RTRI 25
END
```

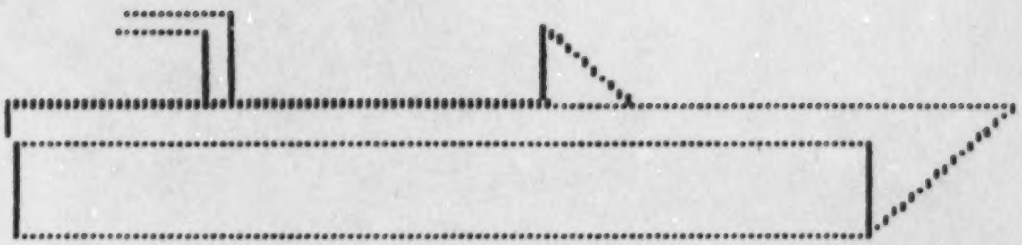
4.2



```
TO STACEY
PU FD 10 LT 90 PD
HT PC 4 LCIRCLE 1.5 RCIRCLE 1
PU RT 90 FD 60 RT 90 FD 4
PD LT 40 FD 25 RT 130 FD 25 RT 90 PU
FD 50 PD RT 90 FD 25 RT 130 FD 25
TAIL
END
```



```
TO BONNIE
PU BK 30 RT 90 BK 50 PD
PC 4 TRI 100 FD 25 LEG
FD 50 LEG FD 25
LT 120 FD 50 ARM
FD 50 LT 120 FD 50 ARM
HEAD
SMILE
END
```

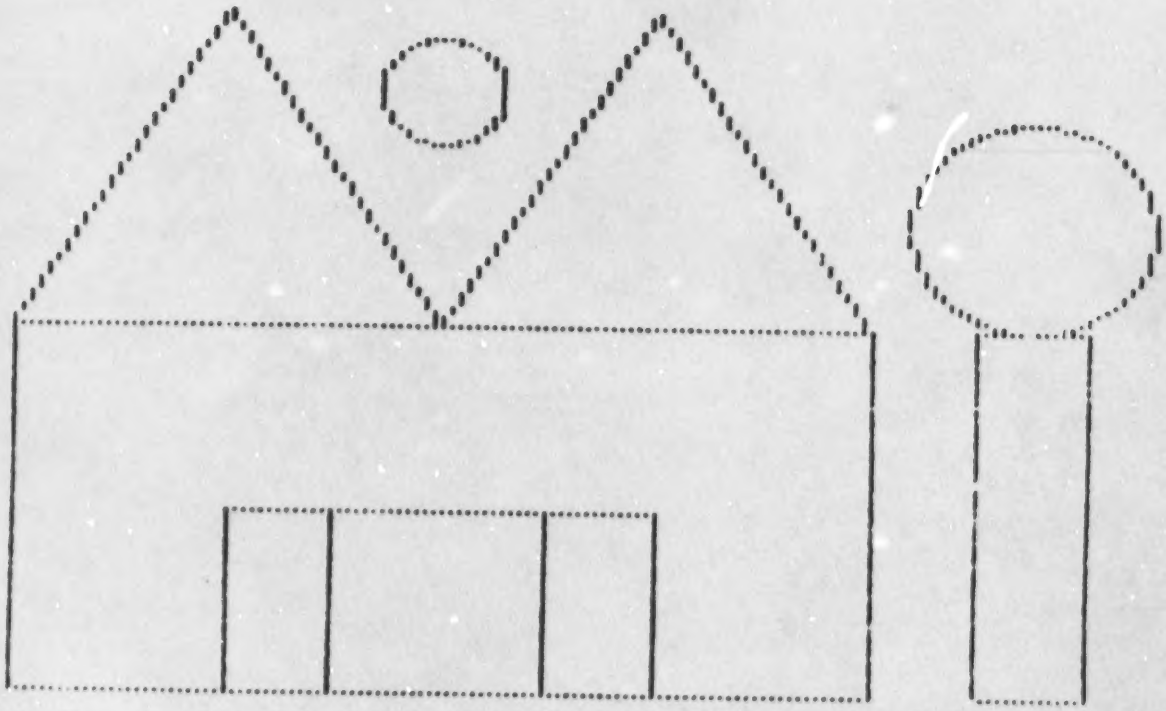


```
TO JON
PU BK 30 LT 90 BK 100 PD
PC 3 REC 200
RT 135 FD 50 LT 135 FD 235
BK 50 RT 90 FD 25 LT 90 FD 25 LT 90 PU
FD 5 PD LT 90 FD 20 RT 90 FD 20 RT 90
BK 100 RT 45 PC 4 FD 30
LT 135 FD 20 LT 90 PC 3 BK 125 RT 90 FD 10
END
```

4.5

and protractor for measuring, and displaying a sense of self confidence in doing so.

The trial and error environment was initially something to which the class was not accustomed. They were embarrassed by mistakes, but they soon learned how easy it was to make a correction. Some transferred the errors to the turtle, as if it had made the mistake. The students had little problem in remembering which key to push for erasing an error in spelling (even though that meant that they had to recall whether they were using LOGO or basic as the two languages use different keys for erasing). The "whoops, I made a mistake" utterances were soon replaced with little acknowledgment that an error had been made, but simply making the correction and seeing if their statement worked. Students with whom this seemed to have the most impact were ones who usually had problems doing the typical pencil and paper exercises. One boy (see Figure 4.6) was particularly noticeable. Even though he is in one of the lowest reading groups, he displayed a real flair for working on the computer. Typically, he had trouble getting his work done. Making corrections, which were often needed, caused him additional problems. However, on the computer, he demonstrated the willingness to not only see a project to the end, but an unmistakable excitement about his accomplishments. On most days, he could be seen bouncing up and down in his chair and clapping his hands, as he viewed his accomplishments.



```
TO TIM
PU BK 70 LT 90 BK 90 RT 90 PD
TALLTREE
PU FD 50 PD PC 2 FD 75
RT 90 REC 50 LT 90 BOX 50
FD 75 RT 90 REC 50
LT 90 FD 50 RT 90
PC 4 TRI 100 FD 100 TRI 100
FD 100 RT 90 PC 2 FD 100
PU RT 90 FD 100 RT 90 FD 150
LT 90 PC 3 PD RCIRCLE .5
END
```

The hypothesis that all students would be active participants in the learning process was a two part statement - the students needed to be more actively involved in their own learning than would normally be expected in a classroom learning experience. It was found that they were more likely to be truly interested and (what to learn on their own intuitive if they had a voice in choosing activities. On the other hand, the teacher (the researcher in this case) became more of a facilitator than a controller of learning. The latter was a hard task, as most traditional teachers are "trained" not to allow students to correct their own mistakes without overt intervention. However, the students often pushed "guiding" hands away as they searched for a key or decided to try an unusual "turtle move." The students were allowed to choose their final projects and all completed them, some with more help than others; but all showing the willingness to finish and then pride in their accomplishment.

The creativity displayed by the students was perhaps the most evident when they were "fooling around" with the amount of "turtle steps" they would input with a "forward" or "back" command. LOGO is set up so that the turtle will wrap around and keep going up to thousands of steps. For example, the students would pick a color, and have the turtle go forward 10,000 "turtle steps;" this caused a continuous line to be drawn. However, it did not take the students long to figure out that if they turned the turtle to the

right or left a small amount, and then entered the forward 10,000 steps command, they had an attractive screen filled with diagonal lines. They they would change the color and direction, and go forward again, creating another interesting design. When the pre-programmed shapes were introduced, some of the students discovered this same procedure could be used with the shapes, such as drawing a triangle, then turning the turtle and drawing another triangle and so on.

Their creativity via the written word was limited to their having time to do one journal entry for their class on the computer. Although, their entries could not be perceived as particularly creative, one notable incident took place while they were engaged in this exercise. The girl in the class, who has been identified as a learning disabled student, and is at the bottom of all the readers in the class became the "resident" speller. She assisted several students in correctly spelling words for their journal entry. The regular classroom teacher was surprised at this performance and could offer no explanation for it.

The hypotheses that the child could begin to develop their use of intuitive thinking on the computer was also difficult to evaluate. Two areas in which it was used was on the heading of the turtle and the number of steps necessary to draw the appropriate length of line. Some of the children did seem to develop a sense of knowing which way the turtle needed to turn to accomplish a

desired result. Some time was spent in having the students estimate the number of turtle steps to move the turtle from one location to another. However, for the most part, the students preferred to use their new found skill of measuring with the "turtle ruler."

The LOGO commands (pen up and pen down) that Dr. Bitter suggested be added to a first grader's LOGO vocabulary were, with the exception of one or two students, understood by the class. Some had more ability to use them and more fully understood the power that they held. On the final project, some of the students tried and succeeded in doing their programs with very little assistance. Most of the students chose "FD" or forward over "BK" or back when they were drawing, but showed no preference for "LT" (left) or "RT" (right). Some of the better programmers remembered that "HT" (hide the turtle) made the turtle draw faster (particularly circles). Due to the unwanted extra lines on some of their pictures, "PU" (pen up) was quickly learned. Then, due to the lack of any pictures being drawn, "PD" (pen down) was also a command that was easily learned. Several of the students (as examples, see Appendix B-4, B-5, B-6, B-7) demonstrated creativity and competency at using LOGO in the final project. All of the students displayed a sense of control over the computer, as they realized, some more consciously than others, that they could decide what the computer could do. For example, they could teach the computer to draw a square. To quote another teacher, observing this phenomena, David Press (Howarth, 1983) commented, "Think about that for a minute - this seven year

old has created a square...for that youngster, it's like inventing a word and having it show up in Webster's...what power it gives the kids...what control over the world he lives in." (p. 122)

In summary, the project did support both Dr. Bitter's proposed curriculum goals as appropriate to the first grade level and most of the hypotheses identified by the researcher. The hypotheses regarding intuitive thinking and understanding of abstract math and geometric principles were the most difficult to support. However, the overall hypothesis that elementary age school children of diverse abilities can learn to feel comfortable with and exert some control over the computer was definitely supported by the project.

Analysis of Working in Pairs

Out of the fourteen pairs, it appeared that only one pair did not work well together. In that instance, the boys were at opposite ends of the ability scale. The student with the lower ability seemed content, but the higher achiever wanted to do more challenging activities and felt that the other student was a hindrance. However, in the other thirteen pairs, the students seemed to benefit from working together. They helped each other to debug programs (correct errors) and seemed to affirm each other's confidence and enhance one another's creativity.

Four pairs seemed to work particularly well together. To take a closer look at these:

Group A: A boy and girl of close to the same ability level; however, the girl was very conscientious about getting her work done, whereas the boy was inclined to do just enough to "get by." However, on the computer, they were the most productive and one of the most creative twosomes. They were a catalyst for one another when it came to remembering how to use the turtle or in trying out new combinations.

Group B: Two girls, one from the upper middle ability level and the other girl from the lowest ability level. It was a case of the better ability student helping the other student, but not in such a way as to intimidate the latter. In short, she was able to help, but without being "bossy" about helping. The result was that the better ability student re-enforced her own learning and became one of the most competent programmers; and, the low ability student also displayed a comprehension of the LOGO language.

Group C: Two girls, both of high ability. Although the one girl was noted for her rank of being the best student in the class, the other girl ignored this. The two were able to channel their efforts into a real understanding of the LOGO commands, which they demonstrated by using the computer with very little assistance from the researcher.

Group D: A girl and boy, the girl from a high level ability group and the boy from one of the lowest ability groups. Again, as in group B, the higher level student was able to teach the lower level student, and to give him some self-confidence, which he did

not display in his other class work. She was so effective in doing this, that on his final project, which he did by himself, he was able to recall most of the needed commands with no assistance.

The fact that the pairs relied on one another was evident when the students were asked to work individually, as they would ask for each other. Moreover, with the students working in pairs, it was faster for the teacher to play the role of facilitator, as the students usually answered each other's questions.

At the beginning of the project, there were twenty-nine children in the class, and therefore, there was one group of three. The group consisted of three girls, and this arrangement was not beneficial, as it was the age old case of two against one in decision-making.

In summary, using the system of two people on the computer at a time facilitated learning and efficient use of the computer.

Can This Project Be Labeled a Piagetian Activity?

Ellis Evans (1971) listed a series of questions to be answered to determine if an activity was a valid Piagetian experience. First, he asked if the teacher and children desired to continue. The evidence of this was the children's continued interest in the project and their disappointment when they were told it was ending. The teacher's desire to continue is evident in that the researcher has asked the principal to allow at least eight of the students to be grouped together next year so that they could continue with computers and LOGO.

Two, Evans asked if a sense of fun is engendered. One of the most surprising developments of this project was that none of the first graders ever asked if they could play games (here, defined as arcade or video games). Furthermore, when offered CAI software, they would use it and do well with it, but most of the students usually tired of it and requested they be allowed to "play with" the turtle. Particularly, when they were "messing around" with the turtle and seeing what they could get it to do, there was a playful atmosphere in which the children were delighted to "work" and share the results of their efforts.

Three, Evans continued by asking if the children are actively involved and persistent. The regular classroom teacher observed that the students were, throughout the project, anxiously awaiting their turn on the computer (see Appendix B-7 for her complete observation).

Finally, the students were actively involved with the computer and each other. The immediate response of the computer to the students encouraged the students' involvement. Whether the students were attaining their desired result or not was immediately visible and allowed for immediate gratification or the chance for immediate correction. In either case, learning could take place because the children could interact spontaneously with the environment, in this case, the computer, and accommodate what this interaction taught them. Moreover, the thrill of discovery almost always caused the students to want to share their experiences with their classmates. Not only did this allow them to learn, too; but,

in their delight for what their fellow classmate had done helped to foster self-confidence in the learner. This, in turn, encouraged the child to want to learn more.

Finally, Evans asked if the new experience helped the teacher to be more responsive. In using the computer, the teacher can be more of a facilitator to the children's learning, because the children can choose their own activities. Therefore, the teacher's role becomes one of being sure the materials and sufficient time are made available for the children to complete these self-initiated activities. Moreover, the teacher can become more responsive to the children's individual needs and feelings. With the computer, each child's experience is unique, even if the children are working in pairs. The observant teacher can perceive a difference in learning styles, a difference in behavior factors that might influence a child's ability to use the computer, such as attention span, frustration tolerance, and perserverance, and the other factors within an environment which will effect the child's ability to learn.

In summary, the project did prove to be consistant with Piagetian principles. The children were actively engaged in a self discovery activity with the teacher acting more as a facilitator than a transmitter of knowledge. By working in pairs, the students also acquired some social knowledge, as they learned there was more than one way to address a problem and gained some practice in interacting with another person.

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

In this final chapter, overall conclusions are drawn, suggestions are made for implementing a computer curriculum at the first grade level, and suggestions are made for further research in this area.

Overall Conclusions

Some conclusions that can be drawn from this limited study are, the following:

1. Programming with LOGO is a viable activity for a normal first grade student within group variations in ability levels.

2. Working in pairs promotes learning. This arrangement is not used by this class for other activities, and the observed benefits would warrant its adoption for other classroom endeavors.

3. Some students who do not succeed in the traditional classroom environment met with obvious success on the computer. The positive effect on their self-esteem was observed by the researcher, regular classroom teacher, and parents.

4. LOGO is a language that invites self discovery. Once the students learn the fundamentals, it is better to let them "learn" by experiment rather than by teacher-planned programs. This attribute makes working with LOGO a natural addition to a Piagetian curriculum.

5. Students reacted positively not only to the computer and to LOGO, but to each other, as there was not a competitive spirit discernable in the classroom. Rather, the attitude perceived was one of delight in one another's accomplishments, and a desire to share what techniques were used to achieve a particular pattern or result on the computer.

Suggestions For A First Grade Computer Curriculum

The following suggestions have been made for the first grade computer curriculum to the local school district involved in this project:

1. Place old typewriters in kindergarten and first grade classes so children can play with them and become familiar with the Qwerty keyboard arrangement.

2. Purchase computers that have cartridges, rather than disk drives, for this age group.

3. Implement LOGO in the first grade and possibly start with kindergarten.

4. A CAI program with which the students can play and learn the keyboard (i.e. "mastertype").

5. Train a group of mother volunteers to work with the children and computers. Mothers, students, and teachers would all benefit.

6. Train teachers in the use of LOGO and show them the value of their students working cooperatively in pairs. If mothers cannot be used (due to union agreements), the teachers could adopt the method used by Nellie Bandelier (1982) of training a group of "expert" students and letting them help the remainder of the class.

7. Give the paired groups at least twenty minutes per week on the computer with access to it at other times if the computer is not being used.

Suggestions for Future Research

1. Is the knowledge gained by working with LOGO carried over to other parts of the curriculum?

2. Can students of this age begin to use different thinking strategies in solving problems?

3. Are there instruments that could be developed to measure some of the process skill development enhanced by LOGO? As Henry Gorman (1982) commented, "It is, of course, a simple matter to assess addition skills. By comparison it is quite complicated to measure thinking, problem-solving, or learning skills." (p. 331)

In summary, the project provided support for the hypothesis that the computer can enhance the education of a first grade class in three areas - academic, social, and affective. All of this can be achieved through a Piagetian experience where the child is encouraged to engage in self discovery. The premise for LOGO could be embodied in the motto of the Lamplighter School - "A child is not a vessel to be filled but a lamp to be lighted." Moreover, many of the benefits of using a computer with children could be summarized as (Howarth, 1983), "It's not something that can be tested. It's the hidden benefit that can't ever be recorded in a teacher's lesson plan book. But when the students master the machine, they are really learning the exciting dimension of their own potential, their own power to grow and discover and to control the world around them." (p. 129) Therefore, although there are still questions to be answered about the use of the computer, the observations made during this project support recommending its use in the elementary schools.

BIBLIOGRAPHY

Abelson, H. A beginner's guide to LOGO. BYTE, August 1982, p. 88-112.

Asimov, I. The word processor and I. Popular Computing, June 1982, p. 24-25.

Austin, H. Teaching teachers LOGO. LOGO Memo No. 23, Cambridge, M.A.: Mit, 1976.

Bandelier, N. TI LOGO and first graders - a winning combination. The Computing Teacher, November 1982, p. 38-39.

Bandelier, N. Personal Communication. March 18, 1982.

Bitter, G. The road to computer literacy. Electronic Learning, Vol. 2, No. 2, p. 34-36.

Bork, A. Preparing student-computer dialog. Taken from The Computer in the School: Tutor, Tool, Tuttee, Taylor, R. P. (ed), New York: Teachers College Press, 1980.

Bork, A. Interactive learning. Taken from The Computer in The School: Tutor, Tool, Tuttee, Taylor, R. P. (ed), New York: Teachers College Press, 1980.

Bork, A. "Learning through graphics." Taken from The Computer in The School: Tutor, Tool, Tuttee, Taylor, R. P. (ed), New York: Teachers College Press, 1980.

Bracey, G. What the research shows. Electronic Learning, November/December 1982, p. 51-53.

Brandt, R. Conversation with John Henry Martin on reading, writing, and computers. Education Leadership, October 1981, p. 60-64.

Carter, R. LOGO and the great debate. Microcomputing, September 1981, p. 48-51.

Coon, M. Papert at the faire. The Computing Teacher, November 1982, p. 14-16.

Derringer, D. Building better math education. Classroom Computer News, November/December 1981, p. 22-23.

Dwyer, T. Heuristic strategies for using computers to enrich education. Taken from The Computer in The School: Tutor, Tool, Tuttee, Taylor, R. P. (ed), New York: Teachers College Press, 1980.

Dwyer, T. Significance of solo mode computing. Taken from The Computer in The School: Tutor, Tool, Tuttee, Taylor, R. P. (ed), New York: Teachers College Press, 1980.

Dwyer, T. Some thoughts on computers and greatness in teaching. Taken from The Computer in The School: Tutor, Tool, Tuttee, Taylor, R. P. (ed), New York: Teachers College Press, 1980.

Evans, E. Contemporary Influences in Early Childhood Education. New York: Holt, Rinehart, and Winston, 1971.

Eyster, R. Seymour Papert and the LOGO universe. Creative Computing, December 1981, p. 70-74.

Favaro, P. My five year old knows basic. Creative Computing, April 1983, p. 158-160.

Goldenberg, E. P. LOGO - a cultural glossary. BYTE, August 1982, p. 210-228.

Gorman, H. The Lamplighter project. BYTE, August 1982, p. 331-332.

Grady, D. A hard look at the world of educational computing. Personal Computing. August 1982, p. 40-44.

Grammer, V., & Goldenberg, E. P. The Terrapin LOGO Language For The Apple II. Cambridge, M.A.: Terrapin, 1982.

Hager, T. David Hoursund: Educating the Educators. Microcomputing, September 1981, p. 56-58.

Harvey, B. Why LOGO. BYTE, August 1982, p. 163-193.

Heck, W. Teaching mathematics with microcomputers: Primary grades. Arithmatic Teacher, February 1983, p. 27 and 63.

Herriott, J. CAI: A philosophy of education and a system to match. Creative Computing, April 1982, p. 80-86.

Howarth, T. Taking a stand for computer education. Personal Computing, May 1983, p. 121-129.

Humphrey, M. All the scientist in the world smushed into one: What kids think about computers. Creative Computing, April 1982, p. 96-98.

Hungate, H. Computers in the kindergarten. The Computing Teacher, January 1982.

Isenberg, R. Cooperation and computing. Classroom Computer News, November/December 1981, p. 24-25.

Jewson, J., & Pea, R. D. LOGO research at Bank Street College. BYTE, August 1982, p. 332-233.

Johnson, D. Student-student interaction: The neglected variable in education. Educational Researcher, January 1981, p. 5-10.

Johnson, D., Maruyama, G., Johnson, R., Nelson, D., & Skon, L. Effects of cooperative, competitive and individualistic goal structure on achievement. Psychological Bulletin, Vol. 89, No. 1, p. 47-62.

Johnson, D., Skon, L., & Johnson, R. Effects of cooperative, competitive and individualistic conditions on children's problem solving performance. American Educational Research Journal, Spring 1980, p. 83-93.

Johnson, J. Educator's lexicon of computerese. Arithmetic Teacher, February 1983, p. 46-49.

Kamii, C., & Devries, R. Physical Knowledge in Preschool Education: Implications of Piaget's Theory. Englewood Cliffs, N.J.: Prentice-Hall, 1978.

Lawler, R. W. One child's learning an intimate study. Unpublished doctoral dissertation, MIT, 1979.

Lawler, R. The progressive construction of the mind. LOGO Memo No. 57, Cambridge, M.A.: MIT, 1980.

Lawler, R. LOGO ideas. Creative Computing, April 1982, p. 138-139.

Lawler, R. LOGO ideas. Creative Computing, May 1982, p. 83.

Lawler, R. W. Designing computer-based microworlds. BYTE, August 1982, p. 138-160.

Lawler, R. LOGO ideas. Creative Computing. September 1982, p. 48.

Lawson, H. Explaining computer related concepts and terminology. Creative Computing, October 1981, p. 92-102.

Lemmond, P. LOGO update. BYTE, August 1982, p. 334-335.

Lough, T. LOGO - How one school is charting the course. Electronic Learning, April 1983, p. 71-75.

Leurhman, A. Should the computer teach the student or vice-versa. In The Computer in The School: Tutor, Tool, Tuttee, Taylor, R. P. (ed), New York: Teachers College Press, 1980.

Martin, K. The learning machine. Arithmetic Teacher, November 1981, p. 41-43.

Martin, K., Bearden, D., & Muller, J. Turtle graphics on and off the computer. The Computing Teacher, November 1982, p. 55-58.

MIT LOGO Group. Assessment and documentation of a children's computer laboratory. LOGO Memo No. 48, Cambridge, M.A.: MIT, 1977.

Muller, J. H. Young people's LOGO association. BYTE, August 1982, p. 333-334.

Nelson, H., & Friedman, R. Seymour Papert: Spearheading the computer revolution. On Computing, Summer 1981, p. 11-12.

Nelson, H. Learning with LOGO. On Computing, Summer 1981, p. 14-16.

Nilson, J. Classroom of the future. Microcomputing, September 1981, p. 36-40.

Olds, H. Through a new looking glass. Microcomputing, September 1981, p. 62-74.

Overcall, T., Lola, P., Murphy, K., Dafoe, M., Housey, J., & Leventhal, S. Learning with LOGO at the Lamplighter School. Microcomputing, September 1981, p. 42-47.

Papert, S. Teaching children to be mathematicians versus teaching about mathematics. Paper presented at Carmel Conference, Carbondale, Ill., November 1970.

Papert, S. Computer laboratory for elementary school. LOGO Memo No. 1, Cambridge, M.A., 1971.

Papert, S. Teaching children thinking. LOGO Memo No. 2, Cambridge, M.A.: MIT, 1972.

Papert, S. Uses of technology to enhance education. LOGO Memo No. 8, Cambridge M.A.: MIT, June 1973.

Papert, S., Watt, D., Disessa, A., & Weir, S. Final report of the Brookline Project Part II. LOGO Memo No. 53, Cambridge, M.A.: MIT, September 1979.

Papert, S. Mindstorms: Children, Computers, and Powerful Ideas. New York: Basic Books, 1980.

Papert, S. Computers and computer cultures. Creative Computing, March 1981, p. 82-92.

Papert, S. Electronic Education, September 1981.

Perlman, R. Tortis. LOGO Memo No. 9. Cambridge, M.A.: MIT December 1974.

Poirot, J. Computers and Education. Austin, Texas: Sterling Swift Publishing, 1980.

Pulaski, M. Understanding Piaget. New York: Harper, 1971.

Reeves, J. Thinking About Thinking. New York, George Braziller, 1965.

Ripple, R., & Rockcastle, U. Piaget Rediscovered. Ithaca, New York: Cornell University Press, 1964.

Riordon, T. Creating a LOGO environment. The Computing Teacher, November 1982, p. 46-50.

Rousseau, J., & Smith, S. Whither goes the turtle. Microcomputing, September 1981, p. 52-55.

Sanger, D. The computer develops some glitches. New York Times, Educational Supplement, January 9, 1983, p. 2-3.

Slavin, R. E. Cooperative learning. Review of Educational Research. Summer 1980, 50(2), p. 315-342.

Solomon, C. Teaching the computer to add: An example of problem solving in an inthropomorphic computer culture. LOGO Memo No. 41, Cambridge, M.A.: MIT, 1976.

Solomon, C. Introducing LOGO to children. BYTE, August 1982, pp. 196-208.

Solomon, C. Leading a child to a computer culture. LOGO Memo No. 20, Cambridge, M.A.: MIT, 1975.

Spencer, D. Microcomputer Coloring Book. Ormond Beach, Florida, Camelot, 1982.

Spencer, M., & Baskin, L. Classroom computers do make a difference. Classroom Computer News, November/December 1981, p. 12-15.

Stein, G., Caputo, P., Pitschka, R., & Wagner, W. J. Action Research roundup. Classroom Computer News, November/December 1981, p. 18-29.

Stuller, J. Creativity. Sky. January 1982, p. 37-42.

Taylor, R. P. (ed.) The Computer in The School: Tutor, Tool, Tutee. New York: Teachers College Press, 1980.

The, L. What did you do in computer class? Personal Computing, September 1981, p. 44-55.

Tobin, C. Developing computer literacy. Arithmetic Teacher, February 1983, p. 22-24.

Upitis, R. Turtle talk: An annotated selection of LOGO programs. The Computing Teacher, November 1982, p. 22-27.

Wadsworth, B. J. Piaget for the Classroom Teacher. New York: Longman, 1978.

Walla, K., & Brubaker, V. Toward a computer literate society - an elementary school responsibility. The Computing Teacher, December 1982, p. 57-59.

Watt, D. Final report on the Brookline Project, Part III. LOGO Memo No. 54, Cambridge, M.A.: MIT, 1979.

Watt D. Teaching turtles. Popular Computing, July 1982, p. 48-5[illegible].

Watt, D. LOGO in the schools. BYTE, August 1982, p. 116-134.

Weir, S., & Watt, D. LOGO: A computer environment for learning disabled students. The Computing Teacher, Vol. 8, No. 5.

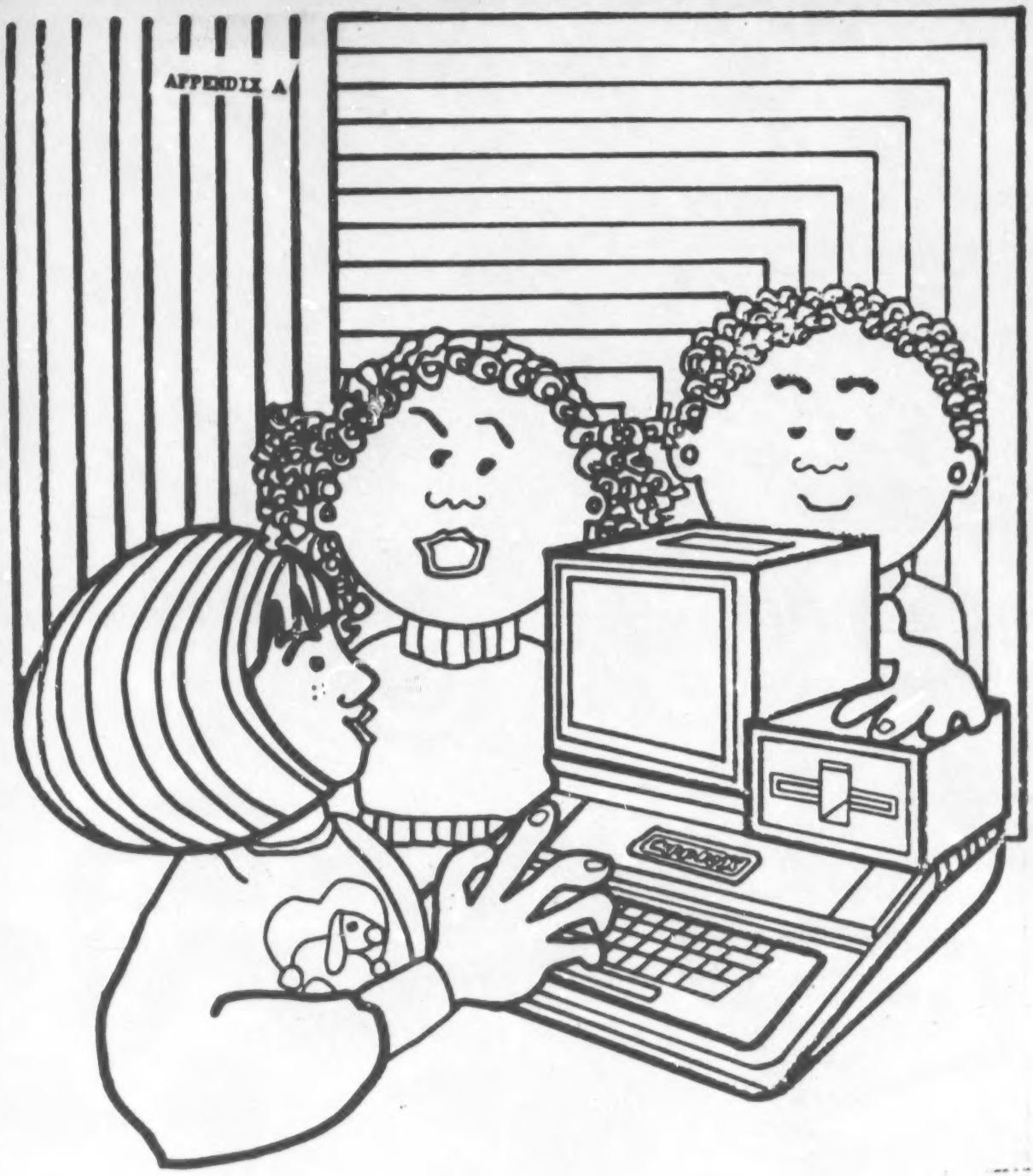
Weir, S. LOGO and the exceptional child. Microcomputing, September 1981, p. 76-84.

Wollman, J. An interview with Alvin Toffler. Popular Computing, December 1982, p. 98-102.

Zinn, K., & Berger, C. What? Me do research? Classroom Computer News, November/December 1981, p. 16-17.

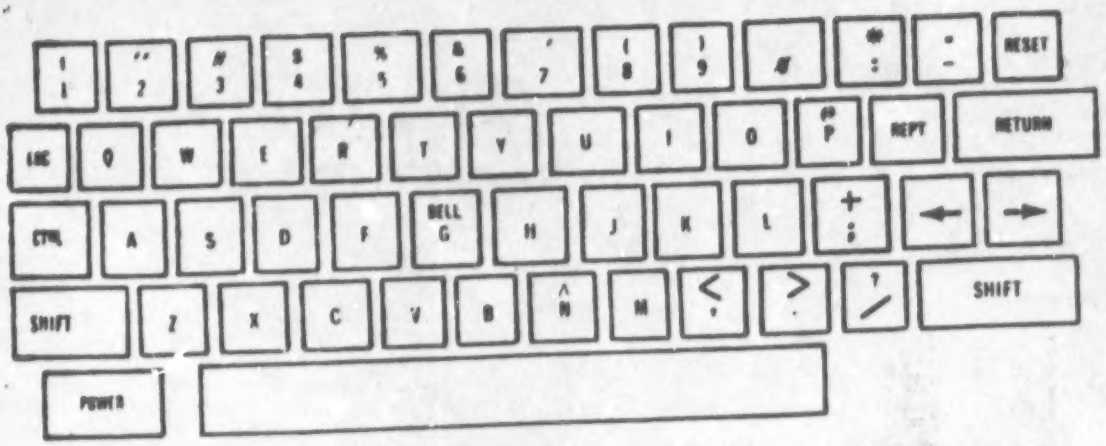
Zonderman, J. Toying with education. Classroom Computer News, September/October 1982, p. 26-28.

APPENDIX A



...from Microcomputing Coloring Book by Dr. S...

APPLE II KEYBOARD

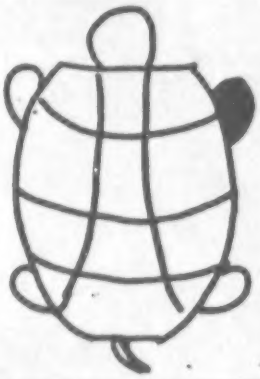


Name :

FD

BK

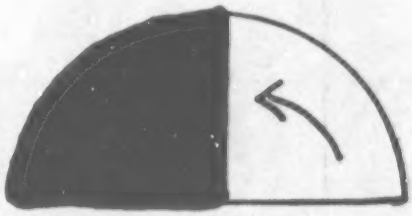
RT



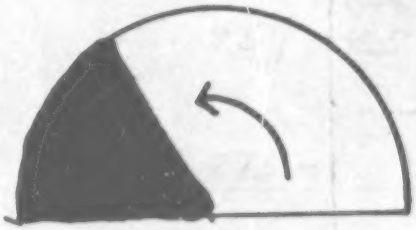
LT

PC :

- ϕ = Black
- 1 = White
- 2 = Green
- 3 = Purple
- 4 = Orange
- 5 = Blue

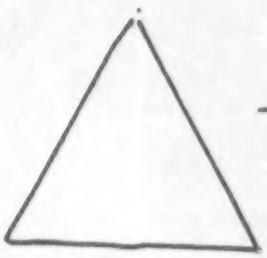


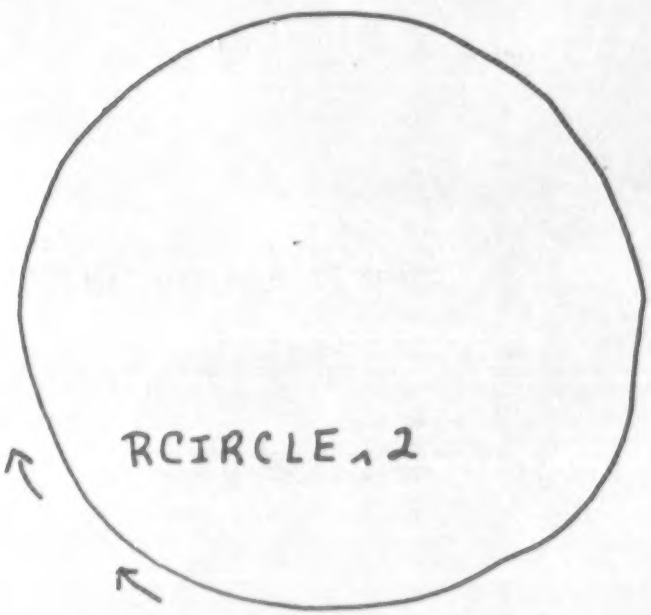
9ϕ

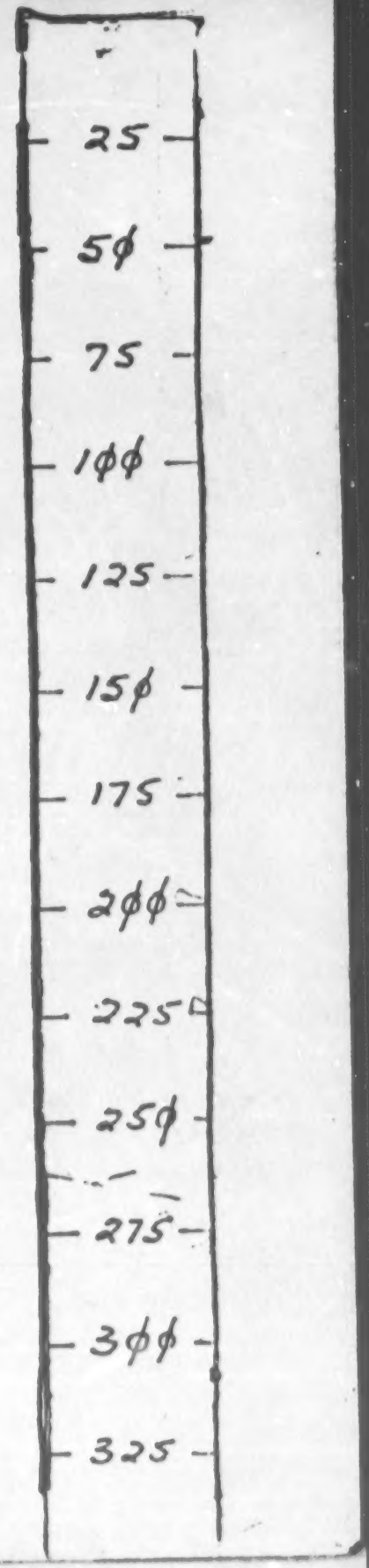


12ϕ

Examples of shapes and "Turtle ruler."







Journal Entries

JAMIE

MARCH 7, 1983

I MADE A FORT. IT IS BIG NOW.

FILMED FROM
BEST COPY AVAILABLE

AMANDA
MARCH 8, 1983
TODAY MY TROOP 584, WILL BE GOING TO ROLLERAMA TODAY.

TIMMY
MARCH 7, 1983.

I SAW A JET PLANE. I SAW TWO OF THEM.

BO

MARCH 7,1983
I WENT TO MY AUNT SUE'S AND TO KENSINGTON.

SUSAN
MARCH 8, 1983
I WENT TO MY GRANDMA'S HOUSE AFTER CHURCH. WE ATE LUNCH THERE.

JON

MARCH 7, 1983

I HAVE A BROTHER. HIS NAME IS CRAIG.

JILL
MARCH 8, 1983

I GOT AN ELEPHANT FOR MY BIRTHDAY. SHE IS CUTE.

APPENDIX B

SAMPLE LIST OF TASKS REQUIRED OF FIRST GRADE STUDENTS AS ADMINISTERED BY SIXTH GRADE STUDENTS

	Load Computer	Spelling Routine	Math Attack	Turn off system Put away disk
JAMIE - GROUP B*	✓	✓	✓	✓
BO - GROUP B	✓	✓	✓	✓
TRACIE - GROUP D	✓	✓	✓	✓
STACEY - GROUP B	✓	✓	✓	✓
GREG - GROUP A	✓	✓	✓	✓
JEREMY - GROUP D	✓	✓	✓	✓
SHANAN - GROUP C	✓	✓	✓	✓
TODD - GROUP A	✓	✓	✓	✓
ETC.				

* DESIGNATED WHICH GROUP OF SPELLING CARDS THE STUDENT WAS TO BE GIVEN.

BEST COPY AVAILABLE

FIRST GRADE POT POURRI
BY BRENDA BRUMMEL

INTRODUCTION

THIS GROUP OF PROGRAMS CAN BE USED WITH A 1ST GRADE LEVEL CLASS. BECAUSE OF THE LACK OF READING SKILLS, THE TEACHER MAY INITIALLY HAVE TO EXPLAIN THE USE OF THE PROGRAMS; HOWEVER, THE PROGRAMS ARE DESIGNED TO GIVE CLUES SO THAT THE STUDENT CAN THEN USE THEM BY HIMSELF.

THE PROGRAMS INCLUDE,

1 MATH FUN:
SIMPLE ADDITION AND SUBRACTION PROBLEMS ARE GENERATED TO GIVE THE STUDENT PRACTICE IN THESE TWO PROCESSES THE PROBLEMS ARE IN SETS OF 10, AND STUDENT IS GIVEN THREE SETS OF 10 WITH THREE CHANCES TO GUESS THE RIGHT ANSWER BEFORE THE CORRECT ANSWER IS DISPLAYED.

2 ABC'S IN ORDER
TWO SEQUENTIAL LETTERS OF THE ALPHABET ARE GIVEN AND THE STUDENT IS ASKED TO ENTER THE FOLLOWING LETTER.

3. BEGINNING SOUNDS:
SOME OBJECTS ARE GRAPHICALLY DISPLAYED ON THE COMPUTER AND THE STUDENT IS TO GUESS THE INITIAL SOUND. IF CORRECT, THE GRAPHIC IS AUGMENTED. IF INCORRECT, FOR 3 TIMES THE CORRECT LETTER IS DISPLAYED.

4. SPELLING:
THE TEACHER ASSIGNS A PACKET OF PICTURES TO THE CLASS OR INDIVIDUAL STUDENT. THE CHILD TAKES THE PACKET TO THE COMPUTER-ENTERS ITS NUMBER, THEN THE CHILD WILL BE ASKED TO SPELL THE WORD THAT IS DISPLAYED IN THE PICTURE.

IN ORDER FOR THE TEACHER TO ADD TO, OR CHANGE THE LIST THE FOLLOWING PROCEDURE SHOULD BE USED

1. BOOT DISK

2. AFTER MENU IS DISPLAYED- PUSH RESET KEY

3. WHEN CURSOR APPEARS- TYPE IN "RUN CREATE A PACKET"

4. THERE ARE CURRENTLY 3 LISTS OF WORDS; SO, FROM THE MENU CHOOSE "READ LIST" AND SELECT #1, #2, OR #3 PACKET. YOU MAY ADD OR CORRECT THESE LISTS.
5. IF YOU WISH TO CREATE A NEW LIST, SELECT PACKET NUMBER 4-20; THEN SIMPLY CHOOSE THE ADD MODE, AND ENTER THE WORDS FOR THE LIST.

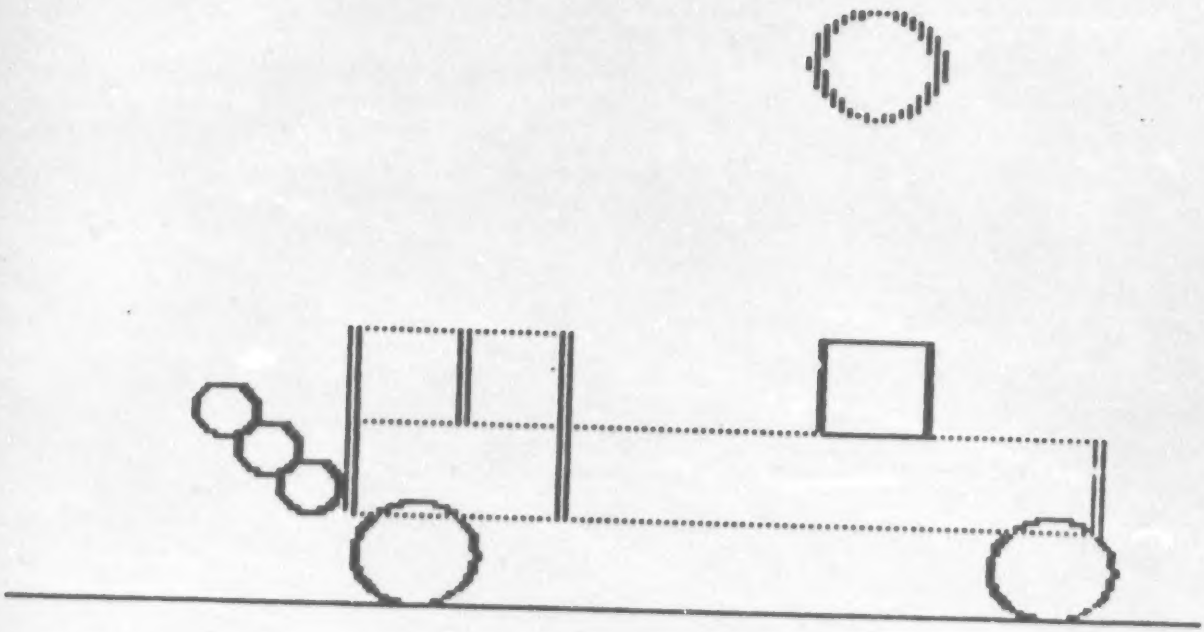
5. GUESS A NUMBER

A SIMPLE GAME OF LOGIC IN WHICH THE COMPUTER SELECTS A NUMBER AND STUDENT TRIES TO GUESS IT. THERE ARE FIVE CHANCES GIVEN WITH SOUND AND COLOR CLUES GIVEN TO HELP ARRIVE AT THE CORRECT ANSWER

6. GUESS WHAT

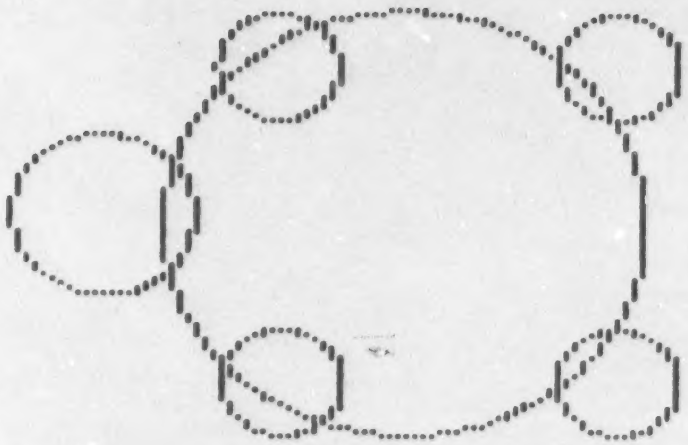
A GAME IN WHICH STUDENT TRIES TO MATCH THE LETTER OR LETTERS THAT ARE BRIEFLY DISPLAYED BY THE COMPUTER. IT IS SUGGESTED THAT THE TEACHER HAVE THE STUDENT START WITH A "1" AT THE SKILL LEVEL.

BEST COPY AVAILABLE

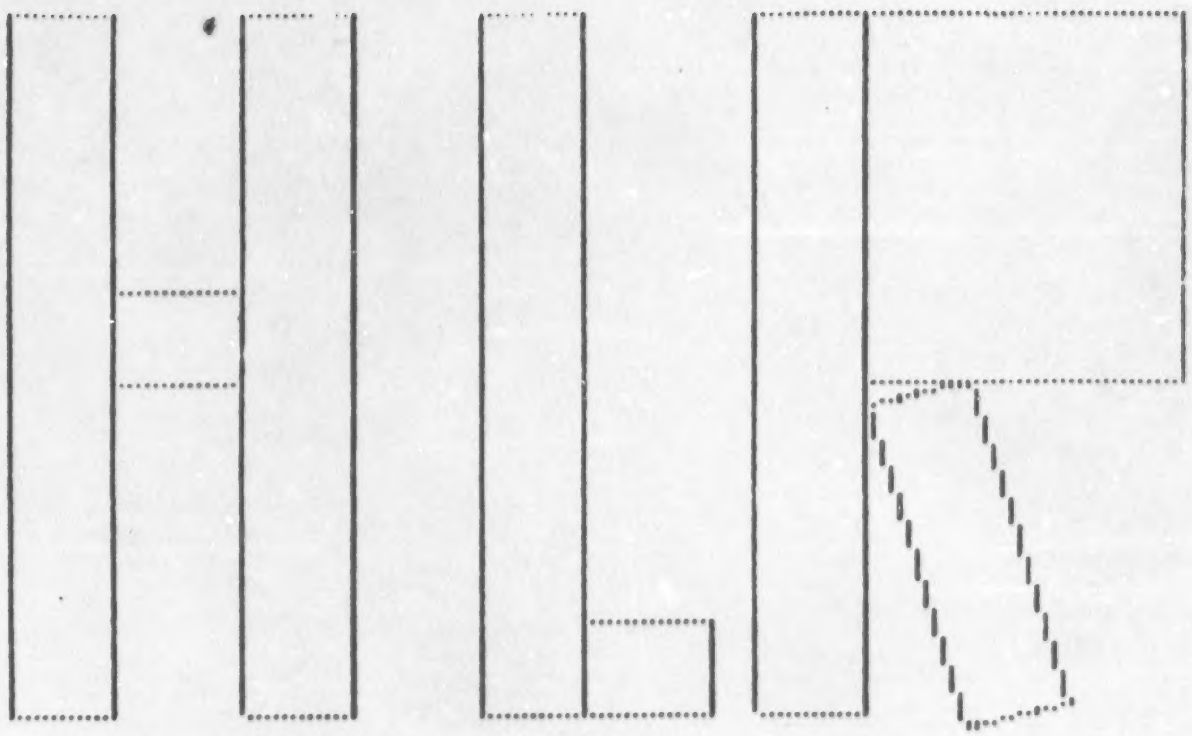


```
TO GREG
PU BK 70 RT 90 BK 140 PD
BG 1 PC 0
FD 300
FD 75 HT
LCIRCLE .5 FD 150 LCIRCLE .5
PU FD 10 LT 90 FD 25 LT 90
PD PC 4 REC 175
FD 175 RT 90 BOX 50 FD 50 RT 90
FD 50 RT 90 BOX 25 PU FD 50 RT 90
FD 60 PD PC 0
REPEAT 3(RCIRCLE .25 PU RT 90 FD 10 LT 90 FD 10 PD)
PU BK 175 LT 90 BK 20 PD BOX 25
PU BK 75 PD PC 4 RCIRCLE .5
```

```
TO SUSAN
PU BK 30 LT 150 PD
PC 2
REPEAT 5(RARC6)
RT 90 FD 60
LT 120 FD 60 LT 30
PU FD 50 LT 90
PD PC 5 FD 10 RHCIR FD 10
RT 130 FD 20 LT 90 FD 20
RT 90 FD 20 LT 90 FD 20
END
```



```
TO BO
PU BK 50 LT 90 PD
HT PC 2 RCIRCLE 2
PU FD 30
PD RCIRCLE .3 PU BK 80
PD RCIRCLE .5 RT 90 PU FD 85 LT 90
PD RCIRCLE .5 PU FD 81
PD RCIRCLE .5 PU FD 20 LT 90 FD 25
PD RCIRCLE .75
END
```



```
TO HOLLY
PU FD 120 RT 90 BK 115 RT 90 PD
PC 3 REC 190 FD 75 LT 90
PC 5 REC 30 FD 30 LT 90
FD 75 RT 90 FD 25 RT 90 REC 190
LT 90 PU FD 55 RT 90
PC 5 PD REC 190 FD 165
LT 90 PC 3 REC 30 PU FD 40 LT 90
BK 25 PD
PC 3 REC 190 FD 190 RT 90 FD 100 RT 90
FD 100 RT 90 FD 75 BK 25 LT 105 REC 90
END
```

To say my class enjoyed their computer unit, would be a great understatement. They kept careful watch of the clock, waiting for the time of Mrs. Brummel's arrival and anxiously awaited their turn on the computer.

They were highly motivated to learn each new concept and were very pleased with their finished product. The fact that every child, regardless of ability, could make the computer show their picture to the class was a great ego builder. They were proud of their accomplishment and also enjoyed each other's accomplishments. This type of empathy is unusual in my class.

The parents of my class have been very impressed with their children's knowledge of computers. The children with home computers have been able to transfer their new knowledge to their computers at home.

Our class has been greatly enriched by this experience.

Deborah Karr